FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-302	**Issued on Date**	05/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Stafford-As-DET
Property	1, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	12.02	**TER**	17.07
Environmental	89 B	**% DER<TER**	29.60		
CO_2 Emissions (t/year)	1.16	**DFEE**	52.01	**TFEE**	60.73
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.36		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Detached House, total floor area 132 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.07 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.02 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.0 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 4.42 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.68 m², No overhang
Windows facing East: 9.37 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing South West: 1.03 m², No overhang
Windows facing West: 6.74 m², No overhang
Windows facing North West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.033 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3679	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4691	0.4599	0.4507	0.4047	0.3955	0.3495	0.3495	0.3403	0.3679	0.3955	0.4139	0.4323	(22b)
Effective ac	0.6100	0.6058	0.6016	0.5819	0.5782	0.5611	0.5611	0.5579	0.5677	0.5782	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5026	68.0228	67.5524	65.3434	64.9301	63.0061	63.0061	62.6498	63.7472	64.9301	65.7662	66.6403	(38)
Heat transfer coeff	170.5839	170.1041	169.6338	167.4248	167.0115	165.0875	165.0875	164.7312	165.8286	167.0115	167.8476	168.7217	(39)
Average = Sum(39)m / 12 =												167.4228	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2932	1.2895	1.2860	1.2692	1.2661	1.2515	1.2515	1.2488	1.2571	1.2661	1.2724	1.2791	(40)
HLP (average)												1.2692	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
								Total per year (kWh/year) = Sum(64)m =				2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	520.8736	518.5965	501.3431	473.1974	444.0352	416.3627	398.6509	405.2388	419.9256	448.3067	480.9607	506.0135	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	691.3322	843.8789	1027.5753	1242.3080	1398.6449	1401.3737	1333.0523	1197.9709	1031.0265	830.8190	691.7730	647.4403	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1264	35.2255	35.3231	35.7892	35.8778	36.2959	36.2959	36.3744	36.1337	35.8778	35.6990	35.5141	
alpha	3.3418	3.3484	3.3549	3.3859	3.3919	3.4197	3.4197	3.4250	3.4089	3.3919	3.3799	3.3676	
util living area													
	0.9933	0.9865	0.9681	0.9164	0.8110	0.6549	0.5115	0.5768	0.8117	0.9555	0.9884	0.9946	(86)
MIT	18.9548	19.1952	19.6119	20.1556	20.6011	20.8674	20.9575	20.9361	20.7067	20.1020	19.4319	18.9207	(87)
Th 2	19.8462	19.8490	19.8518	19.8650	19.8675	19.8790	19.8790	19.8811	19.8746	19.8675	19.8625	19.8573	(88)
util rest of house													
	0.9917	0.9832	0.9602	0.8949	0.7625	0.5691	0.3948	0.4579	0.7438	0.9399	0.9851	0.9934	(89)
MIT 2	17.1218	17.4734	18.0777	18.8559	19.4525	19.7754	19.8580	19.8462	19.6080	18.7980	17.8285	17.0788	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	17.3408	17.6791	18.2610	19.0112	19.5898	19.9059	19.9893	19.9764	19.7393	18.9538	18.0200	17.2988	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1908	17.5291	18.1110	18.8612	19.4398	19.7559	19.8393	19.8264	19.5893	18.8038	17.8700	17.1488	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9856	0.9730	0.9427	0.8702	0.7410	0.5587	0.3904	0.4515	0.7229	0.9188	0.9756	0.9882	(94)
Useful gains	681.3486	821.0575	968.7125	1081.0888	1036.3485	782.8939	520.4298	540.9238	745.2835	763.3895	674.9080	639.8207	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	2198.9698	2148.2605	1969.6216	1667.7519	1292.6278	851.1748	534.7744	564.4417	910.2828	1370.1301	1807.7247	2184.7490 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	1129.1101	891.8804	744.6764	422.3975	190.6718	0.0000	0.0000	0.0000	0.0000	451.4150	815.6281	1149.4266 (98)
Space heating												5795.2058 (98)
Space heating per m2											(98) / (4) =	43.9330 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6410.6258	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1129.1101	891.8804	744.6764	422.3975	190.6718	0.0000	0.0000	0.0000	0.0000	451.4150	815.6281	1149.4266	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1249.0156	986.5933	823.7571	467.2538	210.9201	0.0000	0.0000	0.0000	0.0000	499.3528	902.2434	1271.4896	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.5068	88.3312	87.9246	86.9571	84.9763	79.7000	79.7000	79.7000	79.7000	87.0268	88.1236	88.5728	(217)
Fuel for water heating, kWh/month													
	241.7845	213.3726	224.7440	203.1760	203.3515	193.1253	184.8999	203.6870	203.5762	210.5391	220.5148	235.6147	(219)
Water heating fuel used												2538.3858	(219)
Annual totals kWh/year													
Space heating fuel - main system												6410.6258	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												8280.7790	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6410.6258	0.2160	1384.6952	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2538.3858	0.2160	548.2913	(264)
Space and water heating			1932.9865	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1586.1738	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.0200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		12.0200	ZC1
Total Floor Area	TFA	131.9100	
Assumed number of occupants	N	2.8998	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.4773	ZC2
CO2 emissions from cooking, equation (L16)		1.4297	ZC3
Total CO2 emissions		26.9270	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.9270	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500	(1b)	x 2.5400	(2b) =	169.0370	(1b) - (3b)
First floor	65.3600	(1c)	x 2.6200	(2c) =	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3676	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3676	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4686	0.4594	0.4502	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6055	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5675	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			26.5700	1.3258	35.2254			(27)
GF B&B J150 P/A=0.50			66.5500	0.1300	8.6515			(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.1800	25.0884			(29a)
Plane Ceiling	65.3600		65.3600	0.1300	8.4968			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		82.3015			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.7826	(36)
Total fabric heat loss					(33) + (36) =		96.0841	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.4766	67.9977	67.5284	65.3240	64.9116	62.9917	62.9917	62.6361	63.7312	64.9116	65.7460	66.6182	(38)
Heat transfer coeff	164.5606	164.0818	163.6125	161.4081	160.9957	159.0757	159.0757	158.7202	159.8153	160.9957	161.8300	162.7023	(39)
Average = Sum(39)m / 12 =												161.4062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2475	1.2439	1.2403	1.2236	1.2205	1.2059	1.2059	1.2032	1.2115	1.2205	1.2268	1.2334	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998	(42)
Average daily hot water use (litres/day)	103.0697	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day): 1.5003 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8102 (55)
Total storage loss
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (56)
If cylinder contains dedicated solar storage
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
216.5120 190.7473 200.1215 179.1111 175.3169 156.3560 149.8816 164.8549 164.6854 185.7418 196.7608 211.2068 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
216.5120 190.7473 200.1215 179.1111 175.3169 156.3560 149.8816 164.8549 164.6854 185.7418 196.7608 211.2068 (64)
Total per year (kWh/year) = Sum(64)m = 2191.2959 (64)
Heat gains from water heating, kWh/month
94.6068 83.8514 89.1570 81.4414 80.9094 73.8754 72.4522 77.4308 76.6449 84.3757 87.3100 92.8428 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	127.1597	124.7788	119.8346	113.1131	108.7492	102.6047	97.3820	104.0737	106.4513	113.4082	121.2638	124.7888	(72)
Total internal gains													
	523.5793	521.3022	504.0488	475.9032	446.7409	419.0684	401.3566	407.9445	422.6313	451.0124	483.6664	508.7193	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
East	9.3700	19.6403	0.6300	0.7000	0.7700	56.2417	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
Southwest	1.0300	36.7938	0.6300	0.7000	0.7700	11.5820	(79)
West	6.7400	19.6403	0.6300	0.7000	0.7700	40.4556	(80)
Northwest	1.0300	11.2829	0.6300	0.7000	0.7700	3.5517	(81)

Solar gains	147.0762	280.6621	454.0469	663.6086	823.6621	849.8932	806.2259	683.9899	527.2738	330.0416	181.8944	122.0267	(83)
Total gains	670.6555	801.9643	958.0957	1139.5118	1270.4030	1268.9616	1207.5825	1091.9344	949.9051	781.0540	665.5608	630.7460	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6659	55.8283	55.9885	56.7531	56.8985	57.5852	57.5852	57.7142	57.3188	56.8985	56.6052	56.3017	
alpha	4.7111	4.7219	4.7326	4.7835	4.7932	4.8390	4.8390	4.8476	4.8213	4.7932	4.7737	4.7534	
util living area													
	0.9990	0.9975	0.9918	0.9669	0.8877	0.7268	0.5615	0.6339	0.8837	0.9860	0.9979	0.9993	(86)
MIT	19.5462	19.7108	20.0039	20.4019	20.7403	20.9325	20.9845	20.9732	20.8146	20.3644	19.8869	19.5251	(87)
Th 2	19.8822	19.8850	19.8879	19.9011	19.9036	19.9152	19.9152	19.9174	19.9108	19.9036	19.8986	19.8933	(88)
util rest of house													
	0.9987	0.9966	0.9887	0.9535	0.8431	0.6319	0.4322	0.5014	0.8187	0.9784	0.9970	0.9990	(89)
MIT 2	17.9411	18.1836	18.6125	19.1920	19.6465	19.8702	19.9096	19.9063	19.7551	19.1483	18.4510	17.9179	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	18.1329	18.3661	18.7787	19.3366	19.7772	19.9971	20.0381	20.0338	19.8817	19.2936	18.6225	18.1099	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1329	18.3661	18.7787	19.3366	19.7772	19.9971	20.0381	20.0338	19.8817	19.2936	18.6225	18.1099	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9947	0.9840	0.9443	0.8369	0.6398	0.4475	0.5166	0.8166	0.9721	0.9953	0.9983	(94)
Useful gains	669.1593	797.6855	942.8042	1076.0654	1063.1920	811.8601	540.3716	564.1179	775.6629	759.2349	662.4221	629.6970	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2276.3529	2209.5360	2008.9508	1684.5490	1300.3951	858.5513	546.9126	576.7498	924.0027	1399.6282	1864.6943	2263.1709	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1195.7520	948.7635	793.2131	438.1082	176.4791	0.0000	0.0000	0.0000	0.0000	476.4526	865.6359	1215.3045	(98)
Space heating												6109.7090	(98)
Space heating per m2											(98) / (4) =	46.3173	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6534.4481	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1195.7520	948.7635	793.2131	438.1082	176.4791	0.0000	0.0000	0.0000	0.0000	476.4526	865.6359	1215.3045	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1278.8792	1014.7203	848.3563	468.5649	188.7477	0.0000	0.0000	0.0000	0.0000	509.5750	925.8138	1299.7910	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.5120	190.7473	200.1215	179.1111	175.3169	156.3560	149.8816	164.8549	164.6854	185.7418	196.7608	211.2068	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.6771	88.5133	88.1196	87.1105	84.8315	79.8000	79.8000	79.8000	79.8000	87.2197	88.3071	88.7383	(217)
Fuel for water heating, kWh/month													
	244.1577	215.5013	227.1022	205.6136	206.6649	195.9348	187.8215	206.5850	206.3727	212.9586	222.8143	238.0108	(219)
Water heating fuel used												2569.5374	(219)
Annual totals kWh/year													
Space heating fuel - main system												6534.4481	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Total delivered energy for all uses												9654.3100	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6534.4481	0.2160	1411.4408	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.5374	0.2160	555.0201	(264)
Space and water heating			1966.4609	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Total CO2, kg/m2/year			2252.0793	(272)
Emissions per m2 for space and water heating			14.9076	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8702	(272b)
Emissions per m2 for pumps and fans			0.2951	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9076 * 1.00) + 1.8702 + 0.2951, rounded to 2 d.p.			17.0700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1176	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3386	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3386	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4317	0.4232	0.4147	0.3724	0.3639	0.3216	0.3216	0.3132	0.3386	0.3639	0.3809	0.3978	(22b)
Effective ac	0.5932	0.5895	0.5860	0.5693	0.5662	0.5517	0.5517	0.5490	0.5573	0.5662	0.5725	0.5791	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	66.6076	66.2013	65.8032	63.9329	63.5830	61.9541	61.9541	61.6524	62.5815	63.5830	64.2909	65.0309	(38)
Heat transfer coeff	168.6889	168.2827	167.8845	166.0143	165.6644	164.0354	164.0354	163.7338	164.6629	165.6644	166.3723	167.1123	(39)
Average = Sum(39)m / 12 =												166.0126	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2788	1.2757	1.2727	1.2585	1.2559	1.2435	1.2435	1.2413	1.2483	1.2559	1.2613	1.2669	(40)
HLP (average)												1.2585	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7285	31.2484	32.2456	28.1125	26.9746	23.2770	21.5696	24.7514	25.0470	29.1899	31.8630	34.6012	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	48.0222	46.5006	43.3408	39.0451	36.2561	32.3292	28.9914	33.2680	34.7875	39.2337	44.2542	46.5070	(72)
Total internal gains													
	441.4418	440.0240	424.5550	398.8351	371.2478	345.7929	329.9660	334.1388	347.9676	373.8379	403.6568	427.4375	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	611.9005	765.3064	950.7872	1167.9457	1325.8575	1330.8039	1264.3674	1126.8709	959.0684	756.3502	614.4691	568.8642	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.5210	35.6067	35.6912	36.0933	36.1695	36.5287	36.5287	36.5960	36.3895	36.1695	36.0156	35.8561	
alpha	3.3681	3.3738	3.3794	3.4062	3.4113	3.4352	3.4352	3.4397	3.4260	3.4113	3.4010	3.3904	
util living area													
	0.9954	0.9899	0.9742	0.9273	0.8275	0.6755	0.5319	0.6018	0.8347	0.9653	0.9919	0.9964	(86)
MIT	18.9040	19.1459	19.5663	20.1169	20.5767	20.8556	20.9529	20.9281	20.6790	20.0523	19.3764	18.8669	(87)
Th 2	19.8575	19.8599	19.8623	19.8735	19.8755	19.8853	19.8853	19.8871	19.8816	19.8755	19.8713	19.8669	(88)
util rest of house													
	0.9943	0.9874	0.9676	0.9081	0.7815	0.5902	0.4129	0.4813	0.7712	0.9527	0.9895	0.9956	(89)
MIT 2	17.9438	18.1862	18.6042	19.1474	19.5717	19.8073	19.8691	19.8598	19.6784	19.0966	18.4253	17.9135	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	18.0585	18.3009	18.7191	19.2632	19.6918	19.9325	19.9986	19.9874	19.7980	19.2107	18.5390	18.0274	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0585	18.3009	18.7191	19.2632	19.6918	19.9325	19.9986	19.9874	19.7980	19.2107	18.5390	18.0274	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9917	0.9826	0.9587	0.8951	0.7728	0.5942	0.4257	0.4932	0.7655	0.9426	0.9854	0.9935	(94)
Useful gains	606.8303	751.9951	911.4968	1045.4578	1024.5620	790.7494	538.2775	555.7213	734.1587	712.9064	605.5076	565.1547	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2320.9116	2255.1345	2051.4048	1720.4381	1323.9560	874.7230	557.4938	587.3812	938.2472	1426.4929	1903.1265	2310.7355	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1275.2765	1010.1097	848.0915	485.9858	222.7491	0.0000	0.0000	0.0000	0.0000	530.9083	934.2856	1298.7121	(98)
Space heating												6606.1186	(98)
Space heating per m2											(98) / (4) =	50.0805	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1541.9332	1213.8623	1244.3768	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8054	0.8667	0.8267	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1241.9229	1052.0701	1028.7799	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1674.9000	1594.5213	1436.0873	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	311.7436	403.5837	303.0367	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1018.3639	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	77.9359	100.8959	75.7592	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												254.5910	(107)
Space cooling per m2												1.9300	(108)
Energy for space heating												50.0805	(99)
Energy for space cooling												1.9300	(108)
Total												52.0105	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500	(1b)	x 2.5400	(2b) =	169.0370	(1b) - (3b)
First floor	65.3600	(1c)	x 2.6200	(2c) =	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1176	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3676	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3676	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4686	0.4594	0.4502	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6055	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5675	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			26.5700	1.3258	35.2254			(27)
GF B&B J150 P/A=0.50			66.5500	0.1300	8.6515			(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.1800	25.0884			(29a)
Plane Ceiling	65.3600		65.3600	0.1300	8.4968			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.3015			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.7826	(36)
Total fabric heat loss					(33) + (36) =		96.0841	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.4766	67.9977	67.5284	65.3240	64.9116	62.9917	62.9917	62.6361	63.7312	64.9116	65.7460	66.6182	(38)
Heat transfer coeff	164.5606	164.0818	163.6125	161.4081	160.9957	159.0757	159.0757	158.7202	159.8153	160.9957	161.8300	162.7023	(39)
Average = Sum(39)m / 12 =												161.4062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2475	1.2439	1.2403	1.2236	1.2205	1.2059	1.2059	1.2032	1.2115	1.2205	1.2268	1.2334	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998	(42)
Average daily hot water use (litres/day)	103.0697	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7285	31.2484	32.2456	28.1125	26.9746	23.2770	21.5696	24.7514	25.0470	29.1899	31.8630	34.6012	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	48.0222	46.5006	43.3408	39.0451	36.2561	32.3292	28.9914	33.2680	34.7875	39.2337	44.2542	46.5070	(72)
Total internal gains													
	441.4418	440.0240	424.5550	398.8351	371.2478	345.7929	329.9660	334.1388	347.9676	373.8379	403.6568	427.4375	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
East	9.3700	19.6403	0.6300	0.7000	0.7700	56.2417	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
Southwest	1.0300	36.7938	0.6300	0.7000	0.7700	11.5820	(79)
West	6.7400	19.6403	0.6300	0.7000	0.7700	40.4556	(80)
Northwest	1.0300	11.2829	0.6300	0.7000	0.7700	3.5517	(81)

Solar gains	147.0762	280.6621	454.0469	663.6086	823.6621	849.8932	806.2259	683.9899	527.2738	330.0416	181.8944	122.0267	(83)
Total gains	588.5180	720.6861	878.6018	1062.4438	1194.9099	1195.6861	1136.1919	1018.1287	875.2413	703.8795	585.5511	549.4642	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6659	55.8283	55.9885	56.7531	56.8985	57.5852	57.5852	57.7142	57.3188	56.8985	56.6052	56.3017	
alpha	4.7111	4.7219	4.7326	4.7835	4.7932	4.8390	4.8390	4.8476	4.8213	4.7932	4.7737	4.7534	
util living area													
	0.9994	0.9984	0.9943	0.9745	0.9061	0.7561	0.5919	0.6699	0.9084	0.9908	0.9988	0.9996	(86)
MIT	19.4890	19.6545	19.9502	20.3553	20.7086	20.9196	20.9807	20.9661	20.7834	20.3133	19.8312	19.4682	(87)
Th 2	19.8822	19.8850	19.8879	19.9011	19.9036	19.9152	19.9152	19.9174	19.9108	19.9036	19.8986	19.8933	(88)
util rest of house													
	0.9992	0.9978	0.9920	0.9637	0.8660	0.6625	0.4580	0.5345	0.8518	0.9856	0.9983	0.9995	(89)
MIT 2	18.4998	18.6673	18.9641	19.3730	19.7027	19.8776	19.9103	19.9074	19.7818	19.3384	18.8548	18.4878	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	18.6180	18.7852	19.0819	19.4903	19.8228	20.0021	20.0382	20.0339	19.9015	19.4549	18.9714	18.6049	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6180	18.7852	19.0819	19.4903	19.8228	20.0021	20.0382	20.0339	19.9015	19.4549	18.9714	18.6049	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9970	0.9897	0.9584	0.8625	0.6709	0.4740	0.5503	0.8512	0.9825	0.9976	0.9992	(94)
Useful gains	587.8769	718.5340	869.5770	1018.2805	1030.5820	802.1496	538.5726	560.2748	744.9855	691.5742	584.1485	549.0381	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2356.1732	2278.3163	2058.5573	1709.3671	1307.7426	859.3491	546.9374	576.7781	927.1678	1425.5976	1921.1517	2343.7160	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1315.6125	1048.1737	884.6014	497.5824	206.2075	0.0000	0.0000	0.0000	0.0000	546.1134	962.6423	1335.2404	(98)
Space heating												6796.1735	(98)
Space heating per m2											(98) / (4) =	51.5213	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1495.3120	1177.1605	1206.2735	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8346	0.9015	0.8610	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1248.0497	1061.1549	1038.6077	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1516.9701	1444.7058	1308.9860	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	193.6227	285.3619	201.1615	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												680.1461 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	48.4057	71.3405	50.2904	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												170.0365 (107)
Space cooling per m2												1.2890 (108)
Energy for space heating												51.5213 (99)
Energy for space cooling												1.2890 (108)
Total												52.8103 (109)
Target Fabric Energy Efficiency (TFEE)												60.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1469	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3679	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3863	0.3587	0.3679	0.3495	0.3495	0.3403	0.3311	0.3219	0.3127	0.3403	0.3219	0.3403	(22b)
Effective ac	0.5746	0.5643	0.5677	0.5611	0.5611	0.5579	0.5548	0.5518	0.5489	0.5579	0.5518	0.5579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.5263	63.3719	63.7472	63.0061	63.0061	62.6498	62.3030	61.9657	61.6379	62.6498	61.9657	62.6498	(38)
Heat transfer coeff	166.6077	165.4533	165.8286	165.0875	165.0875	164.7312	164.3844	164.0471	163.7193	164.7312	164.0471	164.7312	(39)
Average = Sum(39)m / 12 =												164.8713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2630	1.2543	1.2571	1.2515	1.2515	1.2488	1.2462	1.2436	1.2411	1.2488	1.2436	1.2488	(40)
HLP (average)												1.2499	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
									Total per year (kWh/year) = Sum(64)m =			2161.6685	(64)
RHI water heating demand												2162	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
East	5.5700	25.1925	0.4600	0.0000	0.7700	49.7022	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	6.7400	25.1925	0.4600	0.0000	0.7700	60.1424	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.8000	25.1925	0.4600	0.0000	0.7700	33.9082	(76)

Solar gains	216.7214	352.8509	576.5167	847.5676	998.4577	1118.1569	1052.8063	916.4825	707.2151	448.0902	267.3672	176.6092	(83)
Total gains	972.5298	1103.4016	1299.2536	1526.8484	1632.6182	1712.3152	1623.8551	1497.0998	1313.0795	1097.6462	965.5352	912.1598	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9647	36.2156	36.1337	36.2959	36.2959	36.3744	36.4511	36.5261	36.5992	36.3744	36.5261	36.3744	
alpha	3.3976	3.4144	3.4089	3.4197	3.4197	3.4250	3.4301	3.4351	3.4399	3.4250	3.4351	3.4250	
util living area													
	0.9795	0.9684	0.9340	0.8497	0.7120	0.5143	0.3848	0.4138	0.6738	0.8907	0.9637	0.9826	(86)
MIT	19.3516	19.5398	19.9426	20.4255	20.7699	20.9443	20.9844	20.9806	20.8595	20.4227	19.8333	19.3367	(87)
Th 2	19.8699	19.8768	19.8746	19.8790	19.8790	19.8811	19.8832	19.8853	19.8872	19.8811	19.8853	19.8811	(88)
util rest of house													
	0.9747	0.9612	0.9189	0.8161	0.6503	0.4254	0.2791	0.3016	0.5871	0.8570	0.9538	0.9785	(89)
MIT 2	17.7120	17.9870	18.5593	19.2249	19.6600	19.8444	19.8772	19.8777	19.7773	19.2419	18.4195	17.6979	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	17.9079	18.1725	18.7245	19.3683	19.7926	19.9759	20.0095	20.0094	19.9066	19.3830	18.5884	17.8937	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7579	18.0225	18.5745	19.2183	19.6426	19.8259	19.8595	19.8594	19.7566	19.2330	18.4384	17.7437	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9615	0.9443	0.8959	0.7925	0.6358	0.4208	0.2768	0.2989	0.5758	0.8321	0.9354	0.9666	(94)
Useful gains	935.0724	1041.9923	1164.0576	1210.0389	1038.0080	720.5144	449.4891	447.4644	756.0147	913.3526	903.1898	881.7048	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	2142.2219	2104.9767	1919.3876	1604.3768	1179.1499	745.5489	453.6214	452.6787	827.8693	1290.3387	1728.8015	2099.2869	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	898.1192	714.3255	561.9655	283.9233	105.0096	0.0000	0.0000	0.0000	0.0000	280.4776	594.4404	905.8811	(98)
Space heating												4344.1421	(98)
RHI space heating demand												4344	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3679	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4691	0.4599	0.4507	0.4047	0.3955	0.3495	0.3495	0.3403	0.3679	0.3955	0.4139	0.4323	(22b)
Effective ac	0.6100	0.6058	0.6016	0.5819	0.5782	0.5611	0.5611	0.5579	0.5677	0.5782	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5026	68.0228	67.5524	65.3434	64.9301	63.0061	63.0061	62.6498	63.7472	64.9301	65.7662	66.6403	(38)
Heat transfer coeff	170.5839	170.1041	169.6338	167.4248	167.0115	165.0875	165.0875	164.7312	165.8286	167.0115	167.8476	168.7217	(39)
Average = Sum(39)m / 12 =												167.4228	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2932	1.2895	1.2860	1.2692	1.2661	1.2515	1.2515	1.2488	1.2571	1.2661	1.2724	1.2791	(40)
HLP (average)												1.2692	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
								Total per year (kWh/year) = Sum(64)m =				2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	926.2670	1075.8330	1248.9691	1448.3914	1588.7702	1579.1693	1505.4501	1373.3494	1216.9653	1032.0683	908.9803	876.9774	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1264	35.2255	35.3231	35.7892	35.8778	36.2959	36.2959	36.3744	36.1337	35.8778	35.6990	35.5141	
alpha	3.3418	3.3484	3.3549	3.3859	3.3919	3.4197	3.4197	3.4250	3.4089	3.3919	3.3799	3.3676	
util living area													
	0.9841	0.9730	0.9465	0.8812	0.7635	0.6016	0.4610	0.5170	0.7488	0.9227	0.9744	0.9866	(86)
MIT	19.1675	19.3981	19.7894	20.2869	20.6761	20.8982	20.9690	20.9543	20.7777	20.2529	19.6239	19.1308	(87)
Th 2	19.8462	19.8490	19.8518	19.8650	19.8675	19.8790	19.8790	19.8811	19.8746	19.8675	19.8625	19.8573	(88)
util rest of house													
	0.9804	0.9668	0.9342	0.8537	0.7103	0.5170	0.3525	0.4051	0.6733	0.8986	0.9675	0.9836	(89)
MIT 2	17.4302	17.7652	18.3277	19.0298	19.5389	19.8018	19.8642	19.8571	19.6814	19.0023	18.1042	17.3838	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.6378	17.9603	18.5023	19.1800	19.6747	19.9328	19.9962	19.9882	19.8124	19.1517	18.2857	17.5925	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4878	17.8103	18.3523	19.0300	19.5247	19.7828	19.8462	19.8382	19.6624	19.0017	18.1357	17.4425	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9690	0.9510	0.9123	0.8287	0.6919	0.5091	0.3492	0.4005	0.6568	0.8740	0.9520	0.9735	(94)
Useful gains	897.5727	1023.1469	1139.4073	1200.3085	1099.2697	803.9657	525.7041	550.0382	799.3371	902.0309	865.3071	853.7427	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	2249.6187	2196.0890	2010.5551	1696.0091	1306.8230	855.6215	535.9019	566.3843	922.4074	1403.1885	1852.3208	2234.3038 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	1005.9222	788.2171	648.1339	356.9045	154.4196	0.0000	0.0000	0.0000	0.0000	372.8613	710.6498	1027.1374 (98)
Space heating												5064.2458 (98)
Space heating per m2											(98) / (4) =	38.3917 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5602.0418 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1005.9222	788.2171	648.1339	356.9045	154.4196	0.0000	0.0000	0.0000	0.0000	372.8613	710.6498	1027.1374	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1112.7458	871.9216	716.9623	394.8058	170.8181	0.0000	0.0000	0.0000	0.0000	412.4571	786.1170	1136.2140	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3200	88.1171	87.6506	86.5525	84.4152	79.7000	79.7000	79.7000	79.7000	86.5705	87.8669	88.3960	(217)
Fuel for water heating, kWh/month													
	242.2958	213.8909	225.4466	204.1258	204.7032	193.1253	184.8999	203.6870	203.5762	211.6488	221.1590	236.0860	(219)
Water heating fuel used												2544.6445	(219)
Annual totals kWh/year													
Space heating fuel - main system												5602.0418	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												7478.4537	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5602.0418	3.4800	194.9511	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2544.6445	3.4800	88.5536	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	475.3244	13.1900	62.6953	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			315.3648	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7487 (257)
SAP value		89.5556
SAP rating (Section 12)		90 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5602.0418	0.2160	1210.0410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2544.6445	0.2160	549.6432	(264)
Space and water heating			1759.6843	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	1412.8715 (272)
CO2 emissions per m2	10.7100 (273)
EI value	89.2982
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8472 = 4.107, stars = 4
Water heating environmental impact	0.216 / 0.8472 = 0.2549, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1469	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3679	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3863	0.3587	0.3679	0.3495	0.3495	0.3403	0.3311	0.3219	0.3127	0.3403	0.3219	0.3403	(22b)
Effective ac	0.5746	0.5643	0.5677	0.5611	0.5611	0.5579	0.5548	0.5518	0.5489	0.5579	0.5518	0.5579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.5263	63.3719	63.7472	63.0061	63.0061	62.6498	62.3030	61.9657	61.6379	62.6498	61.9657	62.6498	(38)
Heat transfer coeff	166.6077	165.4533	165.8286	165.0875	165.0875	164.7312	164.3844	164.0471	163.7193	164.7312	164.0471	164.7312	(39)
Average = Sum(39)m / 12 =												164.8713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2630	1.2543	1.2571	1.2515	1.2515	1.2488	1.2462	1.2436	1.2411	1.2488	1.2436	1.2488	(40)
HLP (average)												1.2499	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
								Total per year (kWh/year) = Sum(64)m =				2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
East	5.5700	25.1925	0.4600	0.0000	0.7700	49.7022	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	6.7400	25.1925	0.4600	0.0000	0.7700	60.1424	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.8000	25.1925	0.4600	0.0000	0.7700	33.9082	(76)

Solar gains	216.7214	352.8509	576.5167	847.5676	998.4577	1118.1569	1052.8063	916.4825	707.2151	448.0902	267.3672	176.6092	(83)
Total gains	972.5298	1103.4016	1299.2536	1526.8484	1632.6182	1712.3152	1623.8551	1497.0998	1313.0795	1097.6462	965.5352	912.1598	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9647	36.2156	36.1337	36.2959	36.2959	36.3744	36.4511	36.5261	36.5992	36.3744	36.5261	36.3744	
alpha	3.3976	3.4144	3.4089	3.4197	3.4197	3.4250	3.4301	3.4351	3.4399	3.4250	3.4351	3.4250	
util living area													
	0.9795	0.9684	0.9340	0.8497	0.7120	0.5143	0.3848	0.4138	0.6738	0.8907	0.9637	0.9826	(86)
MIT	19.3516	19.5398	19.9426	20.4255	20.7699	20.9443	20.9844	20.9806	20.8595	20.4227	19.8333	19.3367	(87)
Th 2	19.8699	19.8768	19.8746	19.8790	19.8790	19.8811	19.8832	19.8853	19.8872	19.8811	19.8853	19.8811	(88)
util rest of house													
	0.9747	0.9612	0.9189	0.8161	0.6503	0.4254	0.2791	0.3016	0.5871	0.8570	0.9538	0.9785	(89)
MIT 2	17.7120	17.9870	18.5593	19.2249	19.6600	19.8444	19.8772	19.8777	19.7773	19.2419	18.4195	17.6979	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.9079	18.1725	18.7245	19.3683	19.7926	19.9759	20.0095	20.0094	19.9066	19.3830	18.5884	17.8937	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7579	18.0225	18.5745	19.2183	19.6426	19.8259	19.8595	19.8594	19.7566	19.2330	18.4384	17.7437	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9615	0.9443	0.8959	0.7925	0.6358	0.4208	0.2768	0.2989	0.5758	0.8321	0.9354	0.9666	(94)
Useful gains	935.0724	1041.9923	1164.0576	1210.0389	1038.0080	720.5144	449.4891	447.4644	756.0147	913.3526	903.1898	881.7048	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	2142.2219	2104.9767	1919.3876	1604.3768	1179.1499	745.5489	453.6214	452.6787	827.8693	1290.3387	1728.8015	2099.2869 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	898.1192	714.3255	561.9655	283.9233	105.0096	0.0000	0.0000	0.0000	0.0000	280.4776	594.4404	905.8811 (98)
Space heating												4344.1421 (98)
Space heating per m2											(98) / (4) =	32.9326 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4805.4669 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	898.1192	714.3255	561.9655	283.9233	105.0096	0.0000	0.0000	0.0000	0.0000	280.4776	594.4404	905.8811	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	993.4947	790.1831	621.6432	314.0744	116.1610	0.0000	0.0000	0.0000	0.0000	310.2629	657.5669	1002.0808	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1235	87.9354	87.3492	85.9727	83.4328	79.7000	79.7000	79.7000	79.7000	85.8460	87.5057	88.1833	(217)
Fuel for water heating, kWh/month													
	242.8362	214.3330	226.2244	205.5024	207.1135	193.1253	184.8999	203.6870	203.5762	213.4351	222.0720	236.6553	(219)
Water heating fuel used												2553.4604	(219)
Annual totals kWh/year													
Space heating fuel - main system												4805.4669	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												6540.2746	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4805.4669	10.2300	491.5993	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2553.4604	10.2300	261.2190	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	475.3244	36.7200	174.5391	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			555.2090	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4805.4669	0.2160	1037.9809	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2553.4604	0.2160	551.5474	(264)
Space and water heating			1589.5283	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			1164.6476	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4805.4669	1.2200	5862.6697	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Water heating (other fuel)	2553.4604	1.2200	3115.2217 (264)
Space and water heating			8977.8913 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	475.3244	3.0700	1459.2460 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			6464.6276 (272)
Primary energy kWh/m2/year			49.0079 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 89

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 120	-265 kg (22.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£120	2.01 kg/m²	B 91	B 91
Total Savings	£120	2.01 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£202	£220	-£18
Mains gas	£856	£718	£138
Space heating	£622	£625	-£3
Water heating	£261	£138	£123
Lighting	£175	£175	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£555	£435	£120
Total cost of uses	£555	£435	£120
Delivered energy	50 kWh/m²	40 kWh/m²	10 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.9 tonnes	0.3 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	49 kWh/m²	38 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1469	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3679	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4691	0.4599	0.4507	0.4047	0.3955	0.3495	0.3495	0.3403	0.3679	0.3955	0.4139	0.4323	(22b)
Effective ac	0.6100	0.6058	0.6016	0.5819	0.5782	0.5611	0.5611	0.5579	0.5677	0.5782	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5026	68.0228	67.5524	65.3434	64.9301	63.0061	63.0061	62.6498	63.7472	64.9301	65.7662	66.6403	(38)
Heat transfer coeff	170.5839	170.1041	169.6338	167.4248	167.0115	165.0875	165.0875	164.7312	165.8286	167.0115	167.8476	168.7217	(39)
Average = Sum(39)m / 12 =												167.4228	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2932	1.2895	1.2860	1.2692	1.2661	1.2515	1.2515	1.2488	1.2571	1.2661	1.2724	1.2791	(40)
HLP (average)												1.2692	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.1279	181.3681	188.3416	162.3083	152.1384	133.7001	126.4705	142.3743	149.2333	173.9619	186.7116	200.8226	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1183	(H8)
Utilisation factor												0.5911	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0697	(H14)
Volume ratio Veff/V												1.0624	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.5522	(H17)
Solar input	-27.3321	-45.6095	-77.6782	-104.1040	-128.6118	-126.4459	-124.7748	-109.0164	-85.3817	-58.3057	-32.4198	-22.8723	(63)
									Solar input (sum of months) = Sum(63)m =			-942.5522	(63)
Output from w/h													
	178.7957	135.7586	110.6634	58.2042	23.5266	7.2542	1.6956	33.3579	63.8516	115.6562	154.2917	177.9503	(64)
									Total per year (kWh/year) = Sum(64)m =			1061.0063	(64)
Heat gains from water heating, kWh/month													
	86.2995	76.3480	79.7331	67.9992	62.3667	55.7507	53.7233	59.4463	64.2833	74.9518	79.2706	84.5355	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	115.9939	113.6131	107.1681	94.4433	83.8262	77.4315	72.2088	79.9010	89.2823	100.7417	110.0981	113.6230	(72)
Total internal gains													
	747.3483	742.0906	712.7760	663.3168	611.9432	571.6908	548.5812	559.1503	591.4012	639.5951	689.7079	727.0905	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	917.8069	1067.3730	1239.0083	1432.4273	1566.5528	1556.7018	1482.9826	1351.8824	1202.5020	1022.1074	900.5202	868.5173	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1264	35.2255	35.3231	35.7892	35.8778	36.2959	36.2959	36.3744	36.1337	35.8778	35.6990	35.5141	
alpha	3.3418	3.3484	3.3549	3.3859	3.3919	3.4197	3.4197	3.4250	3.4089	3.3919	3.3799	3.3676	
util living area													
	0.9845	0.9735	0.9476	0.8841	0.7690	0.6080	0.4671	0.5238	0.7536	0.9245	0.9750	0.9870	(86)
MIT	19.1600	19.3909	19.7818	20.2774	20.6681	20.8948	20.9678	20.9525	20.7729	20.2459	19.6166	19.1232	(87)
Th 2	19.8462	19.8490	19.8518	19.8650	19.8675	19.8790	19.8790	19.8811	19.8746	19.8675	19.8625	19.8573	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9809	0.9675	0.9355	0.8570	0.7162	0.5231	0.3576	0.4109	0.6786	0.9008	0.9683	0.9840	(89)
MIT 2	17.4193	17.7549	18.3170	19.0174	19.5299	19.7990	19.8635	19.8561	19.6766	18.9930	18.0938	17.3728	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.6273	17.9503	18.4920	19.1679	19.6659	19.9299	19.9954	19.9871	19.8076	19.1427	18.2757	17.5819	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4773	17.8003	18.3420	19.0179	19.5159	19.7799	19.8454	19.8371	19.6576	18.9927	18.1257	17.4319	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9697	0.9519	0.9137	0.8320	0.6975	0.5150	0.3541	0.4062	0.6617	0.8763	0.9530	0.9742	(94)
Useful gains	890.0201	1016.0591	1132.1244	1191.7374	1092.6393	801.6733	525.1364	549.1280	795.7323	895.6967	858.2015	846.0726	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2247.8359	2194.4002	2008.8036	1693.9886	1305.3429	855.1413	535.7807	566.1910	921.6100	1401.6795	1850.6437	2232.5137	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1010.2150	791.8452	652.2493	361.6209	158.2514	0.0000	0.0000	0.0000	0.0000	376.4512	714.5584	1031.5122	(98)
Space heating												5096.7036	(98)
Space heating per m2											(98) / (4) =	38.6377	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5637.9464	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1010.2150	791.8452	652.2493	361.6209	158.2514	0.0000	0.0000	0.0000	0.0000	376.4512	714.5584	1031.5122	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1117.4944	875.9349	721.5148	400.0231	175.0569	0.0000	0.0000	0.0000	0.0000	416.4283	790.4407	1141.0533	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	178.7957	135.7586	110.6634	58.2042	23.5266	7.2542	1.6956	33.3579	63.8516	115.6562	154.2917	177.9503	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.6111	88.6580	88.6732	88.7481	88.8561	79.7000	79.7000	79.7000	79.7000	87.6349	88.2950	88.6489	(217)
Fuel for water heating, kWh/month													
	201.7757	153.1262	124.7992	65.5836	26.4772	9.1019	2.1275	41.8543	80.1150	131.9751	174.7458	200.7360	(219)
Water heating fuel used												1212.4176	(219)
Annual totals kWh/year													
Space heating fuel - main system												5637.9464	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6232.1314	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5637.9464	3.4800	196.2005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1212.4176	3.4800	42.1921	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	475.3244	13.1900	62.6953	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			276.8478	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6573	(257)
SAP value		90.8312	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5637.9464	0.2160	1217.7964	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1212.4176	0.2160	261.8822	(264)
Space and water heating			1479.6786	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1158.8159	(272)
CO2 emissions per m2			8.7800	(273)
EI value			91.2226	
EI rating			91	(274)
EI band			B	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3679	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3679	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3863	0.3587	0.3679	0.3495	0.3495	0.3403	0.3311	0.3219	0.3127	0.3403	0.3219	0.3403	(22b)
Effective ac	0.5746	0.5643	0.5677	0.5611	0.5611	0.5579	0.5548	0.5518	0.5489	0.5579	0.5518	0.5579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.5263	63.3719	63.7472	63.0061	63.0061	62.6498	62.3030	61.9657	61.6379	62.6498	61.9657	62.6498	(38)
Heat transfer coeff	166.6077	165.4533	165.8286	165.0875	165.0875	164.7312	164.3844	164.0471	163.7193	164.7312	164.0471	164.7312	(39)
Average = Sum(39)m / 12 =												164.8713	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2630	1.2543	1.2571	1.2515	1.2515	1.2488	1.2462	1.2436	1.2411	1.2488	1.2436	1.2488	(40)
HLP (average)												1.2499	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.1279	181.3681	188.3416	162.3083	152.1384	133.7001	126.4705	142.3743	149.2333	173.9619	186.7116	200.8226	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2516	(H8)
Utilisation factor												0.5502	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0697	(H14)
Volume ratio Veff/V												1.0624	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-981.9633	(H17)
Solar input	-32.0340	-45.5503	-78.2901	-105.6315	-124.0705	-132.5269	-129.7398	-116.1211	-90.9148	-62.8554	-37.8878	-26.3413	(63)
								Solar input (sum of months) = Sum(63)m =				-981.9633	(63)
Output from w/h													
	174.0938	135.8178	110.0515	56.6768	28.0679	1.1732	0.0000	26.2532	58.3186	111.1065	148.8238	174.4814	(64)
								Total per year (kWh/year) = Sum(64)m =				1024.8645	(64)
Heat gains from water heating, kWh/month													
	86.2995	76.3480	79.7331	67.9992	62.3667	55.7507	53.7233	59.4463	64.2833	74.9518	79.2706	84.5355	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	115.9939	113.6131	107.1681	94.4433	83.8262	77.4315	72.2088	79.9010	89.2823	100.7417	110.0981	113.6230	(72)
Total internal gains													
	747.3483	742.0906	712.7760	663.3168	611.9432	571.6908	548.5812	559.1503	591.4012	639.5951	689.7079	727.0905	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
East	5.5700	25.1925	0.4600	0.0000	0.7700	49.7022	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	6.7400	25.1925	0.4600	0.0000	0.7700	60.1424	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.8000	25.1925	0.4600	0.0000	0.7700	33.9082	(76)

Solar gains	216.7214	352.8509	576.5167	847.5676	998.4577	1118.1569	1052.8063	916.4825	707.2151	448.0902	267.3672	176.6092	(83)
Total gains	964.0697	1094.9415	1289.2927	1510.8844	1610.4008	1689.8477	1601.3875	1475.6328	1298.6162	1087.6853	957.0751	903.6998	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9647	36.2156	36.1337	36.2959	36.2959	36.3744	36.4511	36.5261	36.5992	36.3744	36.5261	36.3744	
alpha	3.3976	3.4144	3.4089	3.4197	3.4197	3.4250	3.4301	3.4351	3.4399	3.4250	3.4351	3.4250	
util living area													
	0.9800	0.9690	0.9353	0.8529	0.7178	0.5200	0.3898	0.4193	0.6787	0.8929	0.9646	0.9830	(86)
MIT	19.3442	19.5326	19.9353	20.4172	20.7637	20.9424	20.9838	20.9798	20.8563	20.4165	19.8263	19.3292	(87)
Th 2	19.8699	19.8768	19.8746	19.8790	19.8790	19.8811	19.8832	19.8853	19.8872	19.8811	19.8853	19.8811	(88)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9753	0.9620	0.9204	0.8197	0.6564	0.4305	0.2829	0.3058	0.5921	0.8597	0.9549	0.9790	(89)
MIT 2	17.7013	17.9768	18.5492	19.2143	19.6534	19.8431	19.8770	19.8773	19.7744	19.2341	18.4097	17.6870	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.8976	18.1627	18.7148	19.3580	19.7861	19.9744	20.0092	20.0091	19.9037	19.3753	18.5789	17.8832	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7476	18.0127	18.5648	19.2080	19.6361	19.8244	19.8592	19.8591	19.7537	19.2253	18.4289	17.7332	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9623	0.9453	0.8976	0.7960	0.6415	0.4257	0.2805	0.3030	0.5804	0.8348	0.9367	0.9674	(94)
Useful gains	927.7285	1035.0855	1157.2123	1202.6561	1033.0668	719.3803	449.2613	447.1707	753.7549	907.9642	896.5015	874.2299	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2140.5076	2103.3582	1917.7673	1602.6764	1178.0809	745.3144	453.5713	452.6143	827.3873	1289.0781	1727.2378	2097.5619	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	902.3077	717.8792	565.8529	288.0146	107.8904	0.0000	0.0000	0.0000	0.0000	283.5487	598.1302	910.1590	(98)
Space heating												4373.7827	(98)
Space heating per m2											(98) / (4) =	33.1573	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4838.2552	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	902.3077	717.8792	565.8529	288.0146	107.8904	0.0000	0.0000	0.0000	0.0000	283.5487	598.1302	910.1590	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	998.1279	794.1142	625.9435	318.6002	119.3478	0.0000	0.0000	0.0000	0.0000	313.6601	661.6484	1006.8130	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.0938	135.8178	110.0515	56.6768	28.0679	1.1732	0.0000	26.2532	58.3186	111.1065	148.8238	174.4814	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4788	88.5095	88.4662	88.4475	87.9620	79.7000	79.7000	79.7000	79.7000	87.1077	88.0449	88.4889	(217)
Fuel for water heating, kWh/month													
	196.7633	153.4499	124.3995	64.0796	31.9091	1.4720	0.0000	32.9400	73.1726	127.5508	169.0317	197.1787	(219)
Water heating fuel used												1171.9473	(219)
Annual totals kWh/year													
Space heating fuel - main system												4838.2552	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												5241.5498	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4838.2552	10.2300	494.9535	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1171.9473	10.2300	119.8902	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	475.3244	36.7200	174.5391	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			435.5944	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	4838.2552	0.2160	1045.0631	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1171.9473	0.2160	253.1406	(264)
Space and water heating			1298.2037	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			899.2730	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4838.2552	1.2200	5902.6713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1171.9473	1.2200	1429.7757	(264)
Space and water heating			7332.4470	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	475.3244	3.0700	1459.2460	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4972.6833	(272)
Primary energy kWh/m2/year			37.6975	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	163.5 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		449.17 (P1)
Transmission heat loss coefficient		102.08 (37)
Summer heat loss coefficient		551.25 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.6800	81.1852	0.4600	0.0000	0.9000	258.1299
East	5.5700	117.5071	0.4600	0.0000	0.9000	270.9689
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
South West	1.0300	119.9223	0.4600	0.0000	0.9000	51.1373
West	6.7400	117.5071	0.4600	0.0000	0.9000	327.8870
North West	1.0300	98.8453	0.4600	0.0000	0.9000	42.1496
East	3.8000	117.5071	0.4600	0.0000	0.9000	184.8621
total:						1168.5812

	Jun	Jul	Aug	
Solar gains	1245	1169	1015	(P4)
Internal gains	591	568	578	
Total summer gains	1836	1737	1592	(P5)
Summer gain/loss ratio	3.33	3.15	2.89	(P6)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 163.5)	0.86	0.86	0.86	
Threshold temperature	20.19	21.91	21.54	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-303	**Issued on Date**	16/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-As-SEMI
Property	1, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	11.22	**TER**	17.47
Environmental	91 B	**% DER<TER**	35.76		
CO_2 Emissions (t/year)	0.89	**DFEE**	47.81	**TFEE**	55.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.63		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.47 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.22 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.8 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.80 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.16 m², No overhang
Windows facing East: 7.63 m², No overhang
Windows facing West: 5.81 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4451	0.4364	0.4277	0.3840	0.3753	0.3317	0.3317	0.3229	0.3491	0.3753	0.3928	0.4102	(22b)
Effective ac	0.5991	0.5952	0.5915	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.5376	57.1681	56.8059	55.1047	54.7864	53.3048	53.3048	53.0304	53.8755	54.7864	55.4303	56.1035	(38)
Heat transfer coeff	131.5691	131.1996	130.8374	129.1363	128.8180	127.3363	127.3363	127.0619	127.9070	128.8180	129.4619	130.1350	(39)
Average = Sum(39)m / 12 =												129.1347	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1699	1.1666	1.1634	1.1483	1.1455	1.1323	1.1323	1.1298	1.1374	1.1455	1.1512	1.1572	(40)
HLP (average)												1.1483	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	556.5463	657.6463	779.8545	919.1233	1014.5828	1007.0013	957.5946	871.7144	762.7598	632.1186	546.1872	523.6144	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5133	32.6049	32.6951	33.1258	33.2077	33.5941	33.5941	33.6666	33.4442	33.2077	33.0425	32.8716	
alpha	3.1676	3.1737	3.1797	3.2084	3.2138	3.2396	3.2396	3.2444	3.2296	3.2138	3.2028	3.1914	
util living area	0.9903	0.9829	0.9643	0.9160	0.8218	0.6780	0.5374	0.5965	0.8160	0.9507	0.9846	0.9920	(86)
MIT	18.8725	19.1035	19.5171	20.0628	20.5259	20.8273	20.9404	20.9157	20.6606	20.0385	19.3605	18.8378	(87)
Th 2	19.9441	19.9468	19.9494	19.9616	19.9639	19.9746	19.9746	19.9765	19.9704	19.9639	19.9593	19.9544	(88)
util rest of house	0.9884	0.9794	0.9567	0.8973	0.7807	0.6023	0.4296	0.4891	0.7575	0.9362	0.9809	0.9904	(89)
MIT 2	17.0889	17.4266	18.0270	18.8117	19.4445	19.8255	19.9396	19.9228	19.6398	18.7925	17.8105	17.0445	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	17.6396	17.9443	18.4871	19.1979	19.7784	20.1348	20.2486	20.2294	19.9550	19.1772	18.2891	17.5981	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4896	17.7943	18.3371	19.0479	19.6284	19.9848	20.0986	20.0794	19.8050	19.0272	18.1391	17.4481	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9813	0.9689	0.9406	0.8766	0.7652	0.6031	0.4435	0.5008	0.7464	0.9182	0.9711	0.9844	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	546.1479	637.2081	733.5222	805.6740	776.3616	607.3214	424.7137	436.5958	569.3147	580.3833	530.4123	515.4286	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1735.3402	1691.7291	1548.7290	1310.4658	1021.3146	685.6797	445.4933	467.5075	729.7043	1085.5754	1429.1382	1724.0473	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	884.7591	708.6381	606.5139	363.4501	182.2450	0.0000	0.0000	0.0000	0.0000	375.8629	647.0826	899.2123	(98)
Space heating												4667.7641	(98)
Space heating per m2											(98) / (4) =	41.5060	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5157.7504	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	884.7591	708.6381	606.5139	363.4501	182.2450	0.0000	0.0000	0.0000	0.0000	375.8629	647.0826	899.2123	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	977.6344	783.0256	670.1811	401.6023	201.3757	0.0000	0.0000	0.0000	0.0000	415.3181	715.0084	993.6048	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9438	89.9010	89.8015	89.5695	89.0876	87.3000	87.3000	87.3000	87.3000	89.5671	89.8433	89.9646	(217)
Fuel for water heating, kWh/month	199.6118	175.1028	181.9317	160.4942	155.9203	138.9421	130.3772	147.2980	148.3736	166.5777	179.3773	193.7513	(219)
Water heating fuel used												1977.7580	(219)
Annual totals kWh/year													
Space heating fuel - main system												5157.7504	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6596.2112	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5157.7504	0.2160	1114.0741	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.7580	0.2160	427.1957	(264)
Space and water heating			1541.2698	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1261.3746	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.2200	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		27.3746	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.3746	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3874	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.1800	16.5762			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.3375 (36)
Total fabric heat loss	(33) + (36) =		68.9177 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8288 (42)
Average daily hot water use (litres/day)		101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	94.3798	184.6076	305.4859	450.1283	557.2098	573.2108	544.5435	463.7732	356.5842	219.3014	117.6404	77.6591	(83)
Total gains	554.9725	642.7963	747.2931	865.3256	944.4912	933.9277	888.7122	815.2806	722.6429	612.2016	541.1968	524.5088	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9992	0.9981	0.9940	0.9751	0.9098	0.7586	0.5884	0.6560	0.8990	0.9890	0.9983	0.9994	(86)
MIT	19.6874	19.8287	20.0876	20.4431	20.7519	20.9362	20.9864	20.9769	20.8315	20.4232	19.9957	19.6693	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9989	0.9975	0.9917	0.9649	0.8725	0.6710	0.4652	0.5314	0.8420	0.9830	0.9976	0.9992	(89)
MIT 2	18.2139	18.4226	18.8021	19.3233	19.7447	19.9650	20.0043	20.0015	19.8587	19.3022	18.6766	18.1953	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9964	0.9892	0.9607	0.8750	0.6955	0.5036	0.5700	0.8525	0.9801	0.9967	0.9988	(94)
Useful gains	554.0795	640.4658	739.2284	831.2766	826.4254	649.5287	447.5473	464.7420	616.0288	599.9989	539.3937	523.8811	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1824.3551	1766.5985	1602.5501	1339.6995	1036.6664	693.9811	454.1940	476.9681	745.9130	1122.5917	1494.9370	1812.8701	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	945.0850	756.7612	642.3113	366.0645	156.4193	0.0000	0.0000	0.0000	0.0000	388.8090	687.9912	959.0078	(98)
Space heating												4902.4494	(98)
Space heating per m2											(98) / (4) =	43.5928	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5248.8752	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	945.0850	756.7612	642.3113	366.0645	156.4193	0.0000	0.0000	0.0000	0.0000	388.8090	687.9912	959.0078	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1011.8683	810.2368	687.6995	391.9321	167.4725	0.0000	0.0000	0.0000	0.0000	416.2837	736.6073	1026.7750	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3305	88.1682	87.7763	86.8124	84.7925	80.3000	80.3000	80.3000	80.3000	86.8637	87.9397	88.3940	(217)
Fuel for water heating, kWh/month													
	244.9255	216.2619	228.1041	206.3397	204.5322	190.2188	182.2441	203.1594	205.4031	214.2172	223.7975	238.8460	(219)
Water heating fuel used												2558.0495	(219)
Annual totals kWh/year													
Space heating fuel - main system												5248.8752	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8342.5268	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5248.8752	0.2160	1133.7570	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2558.0495	0.2160	552.5387	(264)
Space and water heating			1686.2957	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1964.2733	(272)
Emissions per m2 for space and water heating			14.9946	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9946 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.4700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4451	0.4364	0.4277	0.3840	0.3753	0.3317	0.3317	0.3229	0.3491	0.3753	0.3928	0.4102	(22b)
Effective ac	0.5991	0.5952	0.5915	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.5376	57.1681	56.8059	55.1047	54.7864	53.3048	53.3048	53.0304	53.8755	54.7864	55.4303	56.1035	(38)
Heat transfer coeff	131.5691	131.1996	130.8374	129.1363	128.8180	127.3363	127.3363	127.0619	127.9070	128.8180	129.4619	130.1350	(39)
Average = Sum(39)m / 12 =												129.1347	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1699	1.1666	1.1634	1.1483	1.1455	1.1323	1.1323	1.1298	1.1374	1.1455	1.1512	1.1572	(40)
HLP (average)												1.1483	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	522.1154	624.0649	748.0371	889.7046	986.7251	981.3389	933.7947	845.5244	735.7179	602.5939	513.8598	490.0294	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9691	32.0591	32.1479	32.5714	32.6519	33.0318	33.0318	33.1031	32.8844	32.6519	32.4895	32.3214	
alpha	3.1313	3.1373	3.1432	3.1714	3.1768	3.2021	3.2021	3.2069	3.1923	3.1768	3.1660	3.1548	
util living area	0.9915	0.9845	0.9668	0.9202	0.8285	0.6871	0.5471	0.6084	0.8256	0.9549	0.9864	0.9931	(86)
MIT	18.8045	19.0401	19.4626	20.0216	20.4992	20.8142	20.9347	20.9074	20.6370	19.9939	19.3012	18.7701	(87)
Th 2	19.9441	19.9468	19.9494	19.9616	19.9639	19.9746	19.9746	19.9765	19.9704	19.9639	19.9593	19.9544	(88)
util rest of house	0.9898	0.9814	0.9598	0.9024	0.7886	0.6121	0.4387	0.5008	0.7692	0.9416	0.9831	0.9917	(89)
MIT 2	17.9291	18.1651	18.5851	19.1388	19.5869	19.8639	19.9480	19.9356	19.7264	19.1229	18.4353	17.9022	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.1994	18.4353	18.8560	19.4114	19.8685	20.1573	20.2526	20.2356	20.0075	19.3918	18.7026	18.1701	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1994	18.4353	18.8560	19.4114	19.8685	20.1573	20.2526	20.2356	20.0075	19.3918	18.7026	18.1701	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9753	0.9503	0.8911	0.7844	0.6266	0.4697	0.5301	0.7715	0.9321	0.9777	0.9883	(94)
Useful gains	514.7090	608.6439	710.8538	792.7732	774.0243	614.9018	438.6398	448.2301	567.6242	561.6707	502.4010	484.2822	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1828.7293	1775.8233	1616.6279	1357.3981	1052.2536	707.6456	465.1116	487.3598	755.6112	1132.5471	1502.0997	1818.0042	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	977.6311	784.3446	673.8959	406.5299	207.0026	0.0000	0.0000	0.0000	0.0000	424.7320	719.7830	992.2892	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating 5186.2083 (98)
Space heating per m2 (98) / (4) = 46.1160 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1196.9613	942.2887	965.6707	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7787	0.8432	0.8075	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	932.0877	794.5789	779.8024	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1251.4879	1193.9056	1094.1190	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	229.9682	297.0990	233.8516	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												760.9188	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.4920	74.2748	58.4629	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												190.2297	(107)
Space cooling per m2												1.6915	(108)
Energy for space heating												46.1160	(99)
Energy for space cooling												1.6915	(108)
Total												47.8076	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.1800	16.5762			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	94.3798	184.6076	305.4859	450.1283	557.2098	573.2108	544.5435	463.7732	356.5842	219.3014	117.6404	77.6591	(83)
Total gains	508.1742	596.8433	703.0952	823.6240	905.0332	897.3454	853.9840	777.4824	683.3063	570.2851	496.4915	478.5522	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9995	0.9987	0.9954	0.9796	0.9215	0.7784	0.6092	0.6812	0.9156	0.9919	0.9989	0.9996	(86)
MIT	19.6483	19.7905	20.0516	20.4121	20.7306	20.9278	20.9841	20.9725	20.8112	20.3897	19.9584	19.6308	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9993	0.9982	0.9936	0.9711	0.8875	0.6922	0.4832	0.5549	0.8643	0.9874	0.9984	0.9995	(89)
MIT 2	18.7343	18.8786	19.1411	19.5071	19.8076	19.9745	20.0053	20.0032	19.8901	19.4904	19.0571	18.7256	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9977	0.9923	0.9688	0.8912	0.7168	0.5226	0.5944	0.8748	0.9860	0.9980	0.9993	(94)
Useful gains	507.6911	595.4486	697.7030	797.9541	806.6087	643.2597	446.3100	462.1464	597.7612	562.3087	495.4867	478.2230	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1868.4932	1805.0048	1630.7129	1354.3062	1041.2410	694.4617	454.1893	476.9464	747.8133	1137.4531	1526.3118	1857.3673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1012.4368	812.8217	694.1593	400.5736	174.5664	0.0000	0.0000	0.0000	0.0000	427.9074	742.1941	1026.0833	(98)
Space heating												5290.7427	(98)
Space heating per m2											(98) / (4) =	47.0456	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8406	0.9093	0.8749	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	968.0437	824.3662	812.6648	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1153.3137	1100.6204	1014.5894	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	133.3944	205.5331	150.2319	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												489.1594	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	33.3486	51.3833	37.5580	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												122.2898	(107)
Space cooling per m2												1.0874	(108)
Energy for space heating												47.0456	(99)
Energy for space cooling												1.0874	(108)
Total												48.1330	(109)
Target Fabric Energy Efficiency (TFEE)												55.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3666	0.3404	0.3491	0.3317	0.3317	0.3229	0.3142	0.3055	0.2968	0.3229	0.3055	0.3229	(22b)
Effective ac	0.5672	0.5579	0.5609	0.5550	0.5550	0.5521	0.5494	0.5467	0.5440	0.5521	0.5467	0.5521	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.4755	53.5865	53.8755	53.3048	53.3048	53.0304	52.7633	52.5036	52.2512	53.0304	52.5036	53.0304	(38)
Heat transfer coeff	128.5070	127.6180	127.9070	127.3363	127.3363	127.0619	126.7949	126.5351	126.2827	127.0619	126.5351	127.0619	(39)
Average = Sum(39)m / 12 =												127.1699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1427	1.1348	1.1374	1.1323	1.1323	1.1298	1.1275	1.1252	1.1229	1.1298	1.1252	1.1298	(40)
HLP (average)												1.1308	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2880	33.5199	33.4442	33.5941	33.5941	33.6666	33.7375	33.8068	33.8744	33.6666	33.8068	33.6666	
alpha	3.2192	3.2347	3.2296	3.2396	3.2396	3.2444	3.2492	3.2538	3.2583	3.2444	3.2538	3.2444	
util living area													
	0.9699	0.9578	0.9226	0.8431	0.7162	0.5296	0.3990	0.4233	0.6704	0.8754	0.9513	0.9737	(86)
MIT	19.3255	19.5030	19.8941	20.3699	20.7284	20.9263	20.9780	20.9740	20.8384	20.3965	19.8113	19.3127	(87)
Th 2	19.9661	19.9725	19.9704	19.9746	19.9746	19.9765	19.9785	19.9803	19.9822	19.9765	19.9803	19.9765	(88)
util rest of house													
	0.9642	0.9499	0.9078	0.8130	0.6619	0.4486	0.3004	0.3199	0.5936	0.8436	0.9403	0.9685	(89)
MIT 2	17.7581	18.0172	18.5734	19.2346	19.6998	19.9219	19.9682	19.9680	19.8444	19.2889	18.4702	17.7468	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2420	18.4759	18.9811	19.5851	20.0174	20.2320	20.2799	20.2786	20.1512	19.6309	18.8843	18.2303	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0920	18.3259	18.8311	19.4351	19.8674	20.0820	20.1299	20.1286	20.0012	19.4809	18.7343	18.0803	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9497	0.9329	0.8872	0.7946	0.6557	0.4574	0.3154	0.3355	0.5952	0.8249	0.9225	0.9552 (94)
Useful gains	766.9998	834.5903	906.7077	925.6307	800.5878	576.7582	377.6330	375.4302	596.7983	714.3807	726.8938	728.2518 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W												
	1695.2661	1662.3410	1513.2837	1265.0941	938.1356	607.6124	384.1800	383.2230	669.4557	1026.7694	1370.9167	1662.0042 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	690.6301	556.2484	451.2925	244.4136	102.3356	0.0000	0.0000	0.0000	0.0000	232.4171	463.6965	694.7118 (98)
Space heating												3435.7457 (98)
RHI space heating demand												3436 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4451	0.4364	0.4277	0.3840	0.3753	0.3317	0.3317	0.3229	0.3491	0.3753	0.3928	0.4102	(22b)
Effective ac	0.5991	0.5952	0.5915	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.5376	57.1681	56.8059	55.1047	54.7864	53.3048	53.3048	53.0304	53.8755	54.7864	55.4303	56.1035	(38)
Heat transfer coeff	131.5691	131.1996	130.8374	129.1363	128.8180	127.3363	127.3363	127.0619	127.9070	128.8180	129.4619	130.1350	(39)
Average = Sum(39)m / 12 =												129.1347	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1699	1.1666	1.1634	1.1483	1.1455	1.1323	1.1323	1.1298	1.1374	1.1455	1.1512	1.1572	(40)
HLP (average)												1.1483	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	777.0833	875.2149	987.3917	1112.2541	1192.7922	1173.7726	1119.4759	1036.5642	937.6410	821.4062	750.3962	739.2614	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5133	32.6049	32.6951	33.1258	33.2077	33.5941	33.5941	33.6666	33.4442	33.2077	33.0425	32.8716	
alpha	3.1676	3.1737	3.1797	3.2084	3.2138	3.2396	3.2396	3.2444	3.2296	3.2138	3.2028	3.1914	
util living area	0.9757	0.9633	0.9357	0.8727	0.7643	0.6116	0.4724	0.5218	0.7400	0.9080	0.9637	0.9790	(86)
MIT	19.1400	19.3580	19.7397	20.2303	20.6274	20.8732	20.9590	20.9431	20.7538	20.2270	19.6014	19.1028	(87)
Th 2	19.9441	19.9468	19.9494	19.9616	19.9639	19.9746	19.9746	19.9765	19.9704	19.9639	19.9593	19.9544	(88)
util rest of house	0.9710	0.9564	0.9233	0.8477	0.7176	0.5359	0.3730	0.4209	0.6730	0.8843	0.9556	0.9750	(89)
MIT 2	17.4761	17.7922	18.3410	19.0366	19.5664	19.8687	19.9514	19.9418	19.7415	19.0491	18.1557	17.4286	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	17.9898	18.2756	18.7728	19.4051	19.8939	20.1788	20.2625	20.2509	20.0540	19.4128	18.6020	17.9455	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1256	18.6228	19.2551	19.7439	20.0288	20.1125	20.1009	19.9040	19.2628	18.4520	17.7955	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9580	0.9401	0.9030	0.8273	0.7065	0.5402	0.3870	0.4339	0.6682	0.8640	0.9396	0.9631	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	744.4081	822.7776	891.6033	920.1458	842.7553	634.0938	433.2292	449.7603	626.4890	709.7267	705.0516	711.9929	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1781.4208	1735.1984	1586.1155	1337.2229	1036.2035	691.2865	447.2640	470.2487	742.3772	1115.9222	1469.6543	1769.2489	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	771.5375	613.1468	516.7171	300.2955	143.9255	0.0000	0.0000	0.0000	0.0000	302.2095	550.5139	786.5985	(98)
Space heating												3984.9442	(98)
Space heating per m2											(98) / (4) =	35.4343	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4403.2533	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	771.5375	613.1468	516.7171	300.2955	143.9255	0.0000	0.0000	0.0000	0.0000	302.2095	550.5139	786.5985	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	852.5276	677.5102	570.9582	331.8182	159.0337	0.0000	0.0000	0.0000	0.0000	333.9331	608.3027	869.1696	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8781	89.8273	89.7101	89.4387	88.8996	87.3000	87.3000	87.3000	87.3000	89.4167	89.7550	89.9022	(217)
Fuel for water heating, kWh/month	199.7578	175.2464	182.1171	160.7289	156.2500	138.9421	130.3772	147.2980	148.3736	166.8579	179.5539	193.8857	(219)
Water heating fuel used												1979.3886	(219)
Annual totals kWh/year													
Space heating fuel - main system												4403.2533	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5843.3447	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4403.2533	3.4800	153.2332	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3886	3.4800	68.8827	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			270.9826	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7228	(257)
SAP value		89.9169	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4403.2533	0.2160	951.1027	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3886	0.2160	427.5479	(264)
Space and water heating			1378.6506	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-1074.8994	0.5190	-557.8728 (269)
Total kg/year			1098.7554 (272)
CO2 emissions per m2			9.7700 (273)
EI value			90.6495
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3666	0.3404	0.3491	0.3317	0.3317	0.3229	0.3142	0.3055	0.2968	0.3229	0.3055	0.3229	(22b)
Effective ac	0.5672	0.5579	0.5609	0.5550	0.5550	0.5521	0.5494	0.5467	0.5440	0.5521	0.5467	0.5521	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.4755	53.5865	53.8755	53.3048	53.3048	53.0304	52.7633	52.5036	52.2512	53.0304	52.5036	53.0304	(38)
Heat transfer coeff	128.5070	127.6180	127.9070	127.3363	127.3363	127.0619	126.7949	126.5351	126.2827	127.0619	126.5351	127.0619	(39)
Average = Sum(39)m / 12 =												127.1699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1427	1.1348	1.1374	1.1323	1.1323	1.1298	1.1275	1.1252	1.1229	1.1298	1.1252	1.1298	(40)
HLP (average)												1.1308	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2880	33.5199	33.4442	33.5941	33.5941	33.6666	33.7375	33.8068	33.8744	33.6666	33.8068	33.6666	
alpha	3.2192	3.2347	3.2296	3.2396	3.2396	3.2444	3.2492	3.2538	3.2583	3.2444	3.2538	3.2444	
util living area	0.9699	0.9578	0.9226	0.8431	0.7162	0.5296	0.3990	0.4233	0.6704	0.8754	0.9513	0.9737	(86)
MIT	19.3255	19.5030	19.8941	20.3699	20.7284	20.9263	20.9780	20.9740	20.8384	20.3965	19.8113	19.3127	(87)
Th 2	19.9661	19.9725	19.9704	19.9746	19.9746	19.9765	19.9785	19.9803	19.9822	19.9765	19.9803	19.9765	(88)
util rest of house	0.9642	0.9499	0.9078	0.8130	0.6619	0.4486	0.3004	0.3199	0.5936	0.8436	0.9403	0.9685	(89)
MIT 2	17.7581	18.0172	18.5734	19.2346	19.6998	19.9219	19.9682	19.9680	19.8444	19.2889	18.4702	17.7468	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2420	18.4759	18.9811	19.5851	20.0174	20.2320	20.2799	20.2786	20.1512	19.6309	18.8843	18.2303	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0920	18.3259	18.8311	19.4351	19.8674	20.0820	20.1299	20.1286	20.0012	19.4809	18.7343	18.0803	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9497	0.9329	0.8872	0.7946	0.6557	0.4574	0.3154	0.3355	0.5952	0.8249	0.9225	0.9552	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Useful gains	766.9998	834.5903	906.7077	925.6307	800.5878	576.7582	377.6330	375.4302	596.7983	714.3807	726.8938	728.2518	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1695.2661	1662.3410	1513.2837	1265.0941	938.1356	607.6124	384.1800	383.2230	669.4557	1026.7694	1370.9167	1662.0042	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	690.6301	556.2484	451.2925	244.4136	102.3356	0.0000	0.0000	0.0000	0.0000	232.4171	463.6965	694.7118	(98)
Space heating												3435.7457	(98)
Space heating per m2											(98) / (4) =	30.5508	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3796.4041 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	690.6301	556.2484	451.2925	244.4136	102.3356	0.0000	0.0000	0.0000	0.0000	232.4171	463.6965	694.7118	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	763.1272	614.6392	498.6658	270.0703	113.0780	0.0000	0.0000	0.0000	0.0000	256.8145	512.3718	767.6373	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8207	89.7741	89.6268	89.2879	88.6294	87.3000	87.3000	87.3000	87.3000	89.2214	89.6524	89.8395	(217)
Fuel for water heating, kWh/month	199.8855	175.3503	182.2863	161.0003	156.7264	138.9421	130.3772	147.2980	148.3736	167.2231	179.7593	194.0211	(219)
Water heating fuel used												1981.2431	(219)
Annual totals kWh/year													
Space heating fuel - main system												3796.4041	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												5092.5248	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3796.4041	10.2300	388.3721	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.2431	10.2300	202.6812	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			442.4763	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3796.4041	0.2160	820.0233	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.2431	0.2160	427.9485	(264)
Space and water heating			1247.9718	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			892.3933	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy	Primary energy factor	Primary energy	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	kWh/year	kg CO2/kWh	kWh/year	
Space heating - main system 1	3796.4041	1.2200	4631.6130	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.2431	1.2200	2417.1166	(264)
Space and water heating			7048.7296	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			4945.4037	(272)
Primary energy kWh/m2/year			43.9748	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (21.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	B 91	A 92
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£694	£589	£105
Space heating	£519	£519	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£448	-£448	£0
Total cost of fuels	£443	£356	£87
Total cost of uses	£443	£356	£87
Delivered energy	45 kWh/m²	37 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	44 kWh/m²	34 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4451	0.4364	0.4277	0.3840	0.3753	0.3317	0.3317	0.3229	0.3491	0.3753	0.3928	0.4102	(22b)
Effective ac	0.5991	0.5952	0.5915	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.5376	57.1681	56.8059	55.1047	54.7864	53.3048	53.3048	53.0304	53.8755	54.7864	55.4303	56.1035	(38)
Heat transfer coeff	131.5691	131.1996	130.8374	129.1363	128.8180	127.3363	127.3363	127.0619	127.9070	128.8180	129.4619	130.1350	(39)
Average = Sum(39)m / 12 =												129.1347	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1699	1.1666	1.1634	1.1483	1.1455	1.1323	1.1323	1.1298	1.1374	1.1455	1.1512	1.1572	(40)
HLP (average)												1.1483	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
								Solar input (sum of months) = Sum(63)m =				-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
								Total per year (kWh/year) = Sum(64)m =				886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	777.0833	875.2149	987.3917	1112.2541	1192.7922	1173.7726	1119.4759	1036.5642	937.6410	821.4062	750.3962	739.2614	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	32.5133	32.6049	32.6951	33.1258	33.2077	33.5941	33.5941	33.6666	33.4442	33.2077	33.0425	32.8716	
alpha	3.1676	3.1737	3.1797	3.2084	3.2138	3.2396	3.2396	3.2444	3.2296	3.2138	3.2028	3.1914	
util living area	0.9757	0.9633	0.9357	0.8727	0.7643	0.6116	0.4724	0.5218	0.7400	0.9080	0.9637	0.9790	(86)

MIT	19.1400	19.3580	19.7397	20.2303	20.6274	20.8732	20.9590	20.9431	20.7538	20.2270	19.6014	19.1028	(87)
Th 2	19.9441	19.9468	19.9494	19.9616	19.9639	19.9746	19.9746	19.9765	19.9704	19.9639	19.9593	19.9544	(88)
util rest of house	0.9710	0.9564	0.9233	0.8477	0.7176	0.5359	0.3730	0.4209	0.6730	0.8843	0.9556	0.9750	(89)
MIT 2	17.4761	17.7922	18.3410	19.0366	19.5664	19.8687	19.9514	19.9418	19.7415	19.0491	18.1557	17.4286	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	17.9898	18.2756	18.7728	19.4051	19.8939	20.1788	20.2625	20.2509	20.0540	19.4128	18.6020	17.9455	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1256	18.6228	19.2551	19.7439	20.0288	20.1125	20.1009	19.9040	19.2628	18.4520	17.7955	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9580	0.9401	0.9030	0.8273	0.7065	0.5402	0.3870	0.4339	0.6682	0.8640	0.9396	0.9631	(94)
Useful gains	744.4081	822.7776	891.6033	920.1458	842.7553	634.0938	433.2292	449.7603	626.4890	709.7267	705.0516	711.9929	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1781.4208	1735.1984	1586.1155	1337.2229	1036.2035	691.2865	447.2640	470.2487	742.3772	1115.9222	1469.6543	1769.2489	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	771.5375	613.1468	516.7171	300.2955	143.9255	0.0000	0.0000	0.0000	0.0000	302.2095	550.5139	786.5985	(98)
Space heating												3984.9442	(98)
Space heating per m2											(98) / (4) =	35.4343	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4403.2533	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	771.5375	613.1468	516.7171	300.2955	143.9255	0.0000	0.0000	0.0000	0.0000	302.2095	550.5139	786.5985	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	852.5276	677.5102	570.9582	331.8182	159.0337	0.0000	0.0000	0.0000	0.0000	333.9331	608.3027	869.1696	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9510	89.9791	90.0054	90.0539	90.1098	87.3000	87.3000	87.3000	87.3000	89.7137	89.8668	89.9629	(217)
Fuel for water heating, kWh/month	171.3330	127.8031	101.2450	52.1051	21.3950	4.2204	0.0000	31.1465	57.4037	105.8551	145.7754	170.1068	(219)
Water heating fuel used												988.3891	(219)
Annual totals kWh/year													
Space heating fuel - main system												4403.2533	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4902.3452	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4403.2533	3.4800	153.2332	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.3891	3.4800	34.3959	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			243.0909	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6484	(257)
SAP value		90.9547	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4403.2533	0.2160	951.1027	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3891	0.2160	213.4921	(264)
Space and water heating			1164.5948	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			910.6495	(272)
CO2 emissions per m2			8.1000	(273)
EI value			92.2503	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3774	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3491	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3666	0.3404	0.3491	0.3317	0.3317	0.3229	0.3142	0.3055	0.2968	0.3229	0.3055	0.3229	(22b)
Effective ac	0.5672	0.5579	0.5609	0.5550	0.5550	0.5521	0.5494	0.5467	0.5440	0.5521	0.5467	0.5521	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.4755	53.5865	53.8755	53.3048	53.3048	53.0304	52.7633	52.5036	52.2512	53.0304	52.5036	53.0304	(38)
Heat transfer coeff	128.5070	127.6180	127.9070	127.3363	127.3363	127.0619	126.7949	126.5351	126.2827	127.0619	126.5351	127.0619	(39)
Average = Sum(39)m / 12 =												127.1699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1427	1.1348	1.1374	1.1323	1.1323	1.1298	1.1275	1.1252	1.1229	1.1298	1.1252	1.1298	(40)
HLP (average)												1.1308	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
								Solar input (sum of months) = Sum(63)m =				-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
									Total per year (kWh/year) = Sum(64)m =			856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	33.2880	33.5199	33.4442	33.5941	33.5941	33.6666	33.7375	33.8068	33.8744	33.6666	33.8068	33.6666	
alpha	3.2192	3.2347	3.2296	3.2396	3.2396	3.2444	3.2492	3.2538	3.2583	3.2444	3.2538	3.2444	
util living area	0.9699	0.9578	0.9226	0.8431	0.7162	0.5296	0.3990	0.4233	0.6704	0.8754	0.9513	0.9737	(86)

MIT	19.3255	19.5030	19.8941	20.3699	20.7284	20.9263	20.9780	20.9740	20.8384	20.3965	19.8113	19.3127	(87)
Th 2	19.9661	19.9725	19.9704	19.9746	19.9746	19.9765	19.9785	19.9803	19.9822	19.9765	19.9803	19.9765	(88)
util rest of house	0.9642	0.9499	0.9078	0.8130	0.6619	0.4486	0.3004	0.3199	0.5936	0.8436	0.9403	0.9685	(89)
MIT 2	17.7581	18.0172	18.5734	19.2346	19.6998	19.9219	19.9682	19.9680	19.8444	19.2889	18.4702	17.7468	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.2420	18.4759	18.9811	19.5851	20.0174	20.2320	20.2799	20.2786	20.1512	19.6309	18.8843	18.2303	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0920	18.3259	18.8311	19.4351	19.8674	20.0820	20.1299	20.1286	20.0012	19.4809	18.7343	18.0803	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9497	0.9329	0.8872	0.7946	0.6557	0.4574	0.3154	0.3355	0.5952	0.8249	0.9225	0.9552	(94)
Useful gains	766.9998	834.5903	906.7077	925.6307	800.5878	576.7582	377.6330	375.4302	596.7983	714.3807	726.8938	728.2518	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1695.2661	1662.3410	1513.2837	1265.0941	938.1356	607.6124	384.1800	383.2230	669.4557	1026.7694	1370.9167	1662.0042	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	690.6301	556.2484	451.2925	244.4136	102.3356	0.0000	0.0000	0.0000	0.0000	232.4171	463.6965	694.7118	(98)
Space heating												3435.7457	(98)
Space heating per m2											(98) / (4) =	30.5508	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3796.4041	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	690.6301	556.2484	451.2925	244.4136	102.3356	0.0000	0.0000	0.0000	0.0000	232.4171	463.6965	694.7118	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	763.1272	614.6392	498.6658	270.0703	113.0780	0.0000	0.0000	0.0000	0.0000	256.8145	512.3718	767.6373	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9127	89.9349	89.9488	89.9818	89.8833	87.3000	87.3000	87.3000	87.3000	89.5778	89.7970	89.9153	(217)
Fuel for water heating, kWh/month	166.5608	127.9537	100.7217	50.6297	26.2210	0.0000	0.0000	23.6468	51.5633	101.3283	140.2471	166.6238	(219)
Water heating fuel used												955.4962	(219)
Annual totals kWh/year													
Space heating fuel - main system												3796.4041	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4116.7779	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3796.4041	10.2300	388.3721	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.4962	10.2300	97.7473	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			355.9024	(255)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3796.4041	0.2160	820.0233	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.4962	0.2160	206.3872	(264)
Space and water heating			1026.4105	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			696.7819	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3796.4041	1.2200	4631.6130	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.4962	1.2200	1165.7054	(264)
Space and water heating			5797.3185	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3847.4926	(272)
Primary energy kWh/m2/year			34.2121	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	74.03	(37)
Summer heat loss coefficient	458.21	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
East	1.000	1.00	1.000	1.000	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.1600	81.1852	0.4600	0.0000	0.9000	72.5990
East	2.1700	117.5071	0.4600	0.0000	0.9000	105.5660
West	5.8100	117.5071	0.4600	0.0000	0.9000	282.6445
East	5.4600	117.5071	0.4600	0.0000	0.9000	265.6177
East	0.6500	176.6135	0.6300	0.7000	1.0000	45.5636
total:						771.9908

	Jun	Jul	Aug	
Solar gains	821	772	674	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1335	1264	1175	(P5)
Summer gain/loss ratio	2.91	2.76	2.56	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.95	21.70	21.41	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-304	**Issued on Date**	16/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	3, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.92	**TER**	17.18
Environmental	91 B	**% DER<TER**	36.44		
CO_2 Emissions (t/year)	0.86	**DFEE**	46.56	**TFEE**	53.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.68		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.18 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.92 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.68 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 7.63 m², No overhang
Windows facing South: 2.16 m², No overhang
Windows facing West: 5.81 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6800	
Infiltration rate		0.3714	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4381	0.4295	0.4209	0.3779	0.3693	0.3264	0.3264	0.3178	0.3436	0.3693	0.3865	0.4037	(22b)
Effective ac	0.5959	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	74.0315 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2374	56.8796	56.5288	54.8813	54.5731	53.1382	53.1382	52.8724	53.6909	54.5731	55.1967	55.8486	(38)
Heat transfer coeff	131.2690	130.9111	130.5604	128.9129	128.6046	127.1697	127.1697	126.9040	127.7224	128.6046	129.2282	129.8801	(39)
Average = Sum(39)m / 12 =												128.9114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1673	1.1641	1.1609	1.1463	1.1436	1.1308	1.1308	1.1284	1.1357	1.1436	1.1491	1.1549	(40)
HLP (average)												1.1463	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	584.1797	700.6792	828.0568	961.0263	1045.3046	1030.3837	983.0985	906.6386	808.9465	676.7959	578.5493	547.7398	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5876	32.6767	32.7645	33.1832	33.2628	33.6381	33.6381	33.7085	33.4925	33.2628	33.1023	32.9361	
alpha	3.1725	3.1784	3.1843	3.2122	3.2175	3.2425	3.2425	3.2472	3.2328	3.2175	3.2068	3.1957	
util living area	0.9889	0.9796	0.9583	0.9069	0.8115	0.6677	0.5258	0.5790	0.7954	0.9415	0.9819	0.9909	(86)
MIT	18.9117	19.1600	19.5751	20.1044	20.5471	20.8355	20.9442	20.9230	20.6895	20.0881	19.4032	18.8723	(87)
Th 2	19.9463	19.9489	19.9514	19.9632	19.9654	19.9758	19.9758	19.9777	19.9718	19.9654	19.9609	19.9562	(88)
util rest of house	0.9867	0.9756	0.9496	0.8868	0.7692	0.5919	0.4194	0.4728	0.7341	0.9248	0.9776	0.9891	(89)
MIT 2	17.1472	17.5094	18.1106	18.8693	19.4717	19.8346	19.9433	19.9292	19.6733	18.8620	17.8731	17.0957	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	17.6919	18.0190	18.5628	19.2506	19.8037	20.1436	20.2523	20.2360	19.9871	19.2405	18.3455	17.6442	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5419	17.8690	18.4128	19.1006	19.6537	19.9936	20.1023	20.0860	19.8371	19.0905	18.1955	17.4942	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9789	0.9639	0.9323	0.8659	0.7546	0.5933	0.4333	0.4849	0.7247	0.9059	0.9668	0.9824	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	571.8519	675.3515	772.0264	832.1577	788.7425	611.3535	426.0180	439.6740	586.2342	613.1102	559.3364	538.1262	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1738.2547	1697.7805	1555.3330	1314.9890	1022.8830	685.8997	445.3855	467.7680	732.7507	1091.9237	1433.8507	1726.6496	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	867.8037	687.0723	582.7802	347.6385	174.2006	0.0000	0.0000	0.0000	0.0000	356.2373	629.6503	884.2614	(98)
Space heating												4529.6442	(98)
Space heating per m2											(98) / (4) =	40.2778	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5005.1317	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	867.8037	687.0723	582.7802	347.6385	174.2006	0.0000	0.0000	0.0000	0.0000	356.2373	629.6503	884.2614	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	958.8991	759.1959	643.9560	384.1309	192.4868	0.0000	0.0000	0.0000	0.0000	393.6324	695.7462	977.0844	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9349	89.8858	89.7794	89.5398	89.0519	87.3000	87.3000	87.3000	87.3000	89.5313	89.8290	89.9570	(217)
Fuel for water heating, kWh/month	199.6316	175.1324	181.9763	160.5473	155.9828	138.9421	130.3772	147.2980	148.3736	166.6444	179.4060	193.7675	(219)
Water heating fuel used												1978.0793	(219)
Annual totals kWh/year													
Space heating fuel - main system												5005.1317	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6443.9139	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5005.1317	0.2160	1081.1085	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.0793	0.2160	427.2651	(264)
Space and water heating			1508.3736	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1228.4783	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.9200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.9200	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		27.0746	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.0746	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3874	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.1800	16.5762			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.3375 (36)
Total fabric heat loss	(33) + (36) =		68.9177 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8288 (42)
Average daily hot water use (litres/day)		101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
South	2.1600	46.7521	0.6300	0.7000	0.7700	30.8622	(78)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	118.2226	221.7375	347.0761	486.2832	583.7173	593.3858	566.5489	493.9066	396.4352	257.8501	145.5633	98.4751	(83)
Total gains	578.8153	679.9263	788.8833	901.4805	970.9987	954.1026	910.7177	845.4140	762.4940	650.7503	569.1197	545.3249	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9990	0.9976	0.9923	0.9707	0.9015	0.7478	0.5759	0.6367	0.8811	0.9857	0.9979	0.9993	(86)
MIT	19.7073	19.8595	20.1212	20.4695	20.7655	20.9404	20.9877	20.9798	20.8502	20.4535	20.0189	19.6867	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9987	0.9967	0.9895	0.9590	0.8621	0.6597	0.4545	0.5138	0.8188	0.9781	0.9970	0.9991	(89)
MIT 2	18.2430	18.4675	18.8507	19.3597	19.7608	19.9684	20.0048	20.0030	19.8784	19.3450	18.7105	18.2208	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9954	0.9866	0.9546	0.8654	0.6845	0.4922	0.5520	0.8315	0.9749	0.9959	0.9986	(94)
Useful gains	577.6921	676.7882	778.3083	860.5806	840.3506	653.0942	448.3007	466.6438	633.9933	634.3841	566.7580	544.5461	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1827.6867	1771.7276	1608.0959	1343.8408	1038.5680	694.4245	454.2877	477.2020	748.2952	1127.4226	1498.7544	1815.7561	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	929.9960	735.7992	617.3620	347.9473	147.4737	0.0000	0.0000	0.0000	0.0000	366.8206	671.0374	945.7802	(98)
Space heating												4762.2166	(98)
Space heating per m2											(98) / (4) =	42.3459	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5098.7329	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	929.9960	735.7992	617.3620	347.9473	147.4737	0.0000	0.0000	0.0000	0.0000	366.8206	671.0374	945.7802	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	995.7131	787.7936	660.9872	372.5346	157.8948	0.0000	0.0000	0.0000	0.0000	392.7416	718.4555	1012.6126	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3039	88.1190	87.6987	86.6942	84.6461	80.3000	80.3000	80.3000	80.3000	86.7287	87.8930	88.3716	(217)
Fuel for water heating, kWh/month													
	244.9993	216.3827	228.3061	206.6212	204.8859	190.2188	182.2441	203.1594	205.4031	214.5504	223.9165	238.9065	(219)
Water heating fuel used												2559.5941	(219)
Annual totals kWh/year													
Space heating fuel - main system												5098.7329	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8193.9292	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5098.7329	0.2160	1101.3263	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2559.5941	0.2160	552.8723	(264)
Space and water heating			1654.1986	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1932.1762	(272)
Emissions per m2 for space and water heating			14.7092	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7092 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.1800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6800	
Infiltration rate		0.3714	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4381	0.4295	0.4209	0.3779	0.3693	0.3264	0.3264	0.3178	0.3436	0.3693	0.3865	0.4037	(22b)
Effective ac	0.5959	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	74.0315 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2374	56.8796	56.5288	54.8813	54.5731	53.1382	53.1382	52.8724	53.6909	54.5731	55.1967	55.8486	(38)
Heat transfer coeff	131.2690	130.9111	130.5604	128.9129	128.6046	127.1697	127.1697	126.9040	127.7224	128.6046	129.2282	129.8801	(39)
Average = Sum(39)m / 12 =												128.9114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1673	1.1641	1.1609	1.1463	1.1436	1.1308	1.1308	1.1284	1.1357	1.1436	1.1491	1.1549	(40)
HLP (average)												1.1463	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	549.7488	667.0978	796.2393	931.6076	1017.4468	1004.7214	959.2986	880.4486	781.9045	647.2712	546.2219	514.1548	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0422	32.1298	32.2161	32.6278	32.7060	33.0751	33.0751	33.1443	32.9319	32.7060	32.5482	32.3848	
alpha	3.1361	3.1420	3.1477	3.1752	3.1804	3.2050	3.2050	3.2096	3.1955	3.1804	3.1699	3.1590	
util living area	0.9902	0.9814	0.9610	0.9113	0.8183	0.6768	0.5351	0.5904	0.8051	0.9461	0.9839	0.9920	(86)
MIT	18.8443	19.0975	19.5218	20.0644	20.5213	20.8229	20.9389	20.9154	20.6676	20.0450	19.3446	18.8051	(87)
Th 2	19.9463	19.9489	19.9514	19.9632	19.9654	19.9758	19.9758	19.9777	19.9718	19.9654	19.9609	19.9562	(88)
util rest of house	0.9882	0.9777	0.9529	0.8921	0.7772	0.6015	0.4281	0.4839	0.7455	0.9306	0.9801	0.9904	(89)
MIT 2	17.9701	18.2233	18.6441	19.1800	19.6068	19.8709	19.9511	19.9407	19.7513	19.1725	18.4794	17.9382	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2400	18.4932	18.9151	19.4530	19.8892	20.1648	20.2561	20.2416	20.0342	19.4418	18.7465	18.2058	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2400	18.4932	18.9151	19.4530	19.8892	20.1648	20.2561	20.2416	20.0342	19.4418	18.7465	18.2058	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9708	0.9427	0.8807	0.7737	0.6165	0.4589	0.5133	0.7497	0.9207	0.9740	0.9867	(94)
Useful gains	540.8338	647.6509	750.6157	820.4945	787.2445	619.4199	440.2515	451.9287	586.1584	595.9467	532.0111	507.3066	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1829.8931	1779.5049	1620.9193	1360.4211	1053.1655	707.6791	464.9399	487.5162	757.9280	1137.0997	1505.0585	1819.0804	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	959.0602	760.6059	647.5059	388.7471	197.8452	0.0000	0.0000	0.0000	0.0000	402.6178	700.5941	975.9597	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating 5032.9359 (98)
Space heating per m2 (98) / (4) = 44.7531 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1195.3951	941.0557	964.4701	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7872	0.8511	0.8204	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	941.0501	800.9503	791.2377	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1278.8180	1223.7154	1134.9394	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	243.1929	314.5372	255.7141	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												813.4442	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.7982	78.6343	63.9285	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												203.3611	(107)
Space cooling per m2												1.8083	(108)
Energy for space heating												44.7531	(99)
Energy for space cooling												1.8083	(108)
Total												46.5614	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.1800	16.5762			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
South	2.1600	46.7521	0.6300	0.7000	0.7700	30.8622	(78)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	118.2226	221.7375	347.0761	486.2832	583.7173	593.3858	566.5489	493.9066	396.4352	257.8501	145.5633	98.4751	(83)
Total gains	532.0170	633.9732	744.6854	859.7790	931.5408	917.5204	875.9895	807.6159	723.1574	608.8338	524.4144	499.3683	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9994	0.9982	0.9941	0.9757	0.9137	0.7675	0.5959	0.6610	0.8988	0.9892	0.9986	0.9995	(86)
MIT	19.6682	19.8214	20.0855	20.4390	20.7451	20.9326	20.9856	20.9760	20.8317	20.4205	19.9817	19.6482	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9991	0.9976	0.9918	0.9658	0.8775	0.6805	0.4717	0.5360	0.8417	0.9834	0.9980	0.9994	(89)
MIT 2	18.7542	18.9094	19.1746	19.5328	19.8195	19.9772	20.0057	20.0044	19.9054	19.5204	19.0804	18.7430	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	19.0364	19.1910	19.4558	19.8126	20.1053	20.2721	20.3083	20.3044	20.1914	19.7983	19.3587	19.0225	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0364	19.1910	19.4558	19.8126	20.1053	20.2721	20.3083	20.3044	20.1914	19.7983	19.3587	19.0225	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9969	0.9903	0.9635	0.8820	0.7055	0.5105	0.5751	0.8543	0.9818	0.9974	0.9992	(94)
Useful gains	531.3931	632.0365	737.4260	828.4010	821.6047	647.3075	447.2064	464.4511	617.7973	597.7587	523.0555	498.9494	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1871.0204	1808.9045	1634.9596	1357.5537	1042.8203	694.8687	454.2847	477.1854	749.8923	1141.2055	1529.2150	1859.5553	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	996.6827	790.8553	667.7650	380.9900	164.5844	0.0000	0.0000	0.0000	0.0000	404.3244	724.4348	1012.2908	(98)
Space heating												5141.9274	(98)
Space heating per m2											(98) / (4) =	45.7223	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8490	0.9159	0.8869	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	977.6694	830.3262	823.8374	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1176.8948	1126.3410	1049.8104	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	143.4423	220.2351	168.1239	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												531.8013	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	35.8606	55.0588	42.0310	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												132.9503	(107)
Space cooling per m2												1.1822	(108)
Energy for space heating												45.7223	(99)
Energy for space cooling												1.1822	(108)
Total												46.9045	(109)
Target Fabric Energy Efficiency (TFEE)												53.9	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6800	
Infiltration rate			0.3714	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3006	0.2920	0.3178	0.3006	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5426	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2719	53.4110	53.6909	53.1382	53.1382	52.8724	52.6138	52.3622	52.1178	52.8724	52.3622	52.8724	(38)
Heat transfer coeff	128.3035	127.4425	127.7224	127.1697	127.1697	126.9040	126.6453	126.3938	126.1493	126.9040	126.3938	126.9040	(39)
Average = Sum(39)m / 12 =												127.0085	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1409	1.1332	1.1357	1.1308	1.1308	1.1284	1.1261	1.1239	1.1217	1.1284	1.1239	1.1284	(40)
HLP (average)												1.1294	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3409	33.5661	33.4925	33.6381	33.6381	33.7085	33.7774	33.8446	33.9102	33.7085	33.8446	33.7085	
alpha	3.2227	3.2377	3.2328	3.2425	3.2425	3.2472	3.2518	3.2563	3.2607	3.2472	3.2563	3.2472	
util living area	0.9665	0.9524	0.9139	0.8322	0.7067	0.5219	0.3915	0.4115	0.6499	0.8606	0.9450	0.9709	(86)
MIT	19.3670	19.5535	19.9423	20.3996	20.7401	20.9296	20.9793	20.9762	20.8532	20.4357	19.8545	19.3488	(87)
Th 2	19.9676	19.9738	19.9718	19.9758	19.9758	19.9777	19.9795	19.9814	19.9831	19.9777	19.9814	19.9777	(88)
util rest of house	0.9602	0.9436	0.8978	0.8010	0.6521	0.4416	0.2945	0.3105	0.5730	0.8264	0.9329	0.9653	(89)
MIT 2	17.8185	18.0896	18.6408	19.2737	19.7138	19.9257	19.9699	19.9701	19.8593	19.3398	18.5315	17.7993	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2966	18.5416	19.0426	19.6213	20.0306	20.2356	20.2815	20.2807	20.1661	19.6781	18.9399	18.2777	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1466	18.3916	18.8926	19.4713	19.8806	20.0856	20.1315	20.1307	20.0161	19.5281	18.7899	18.1277	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9449	0.9257	0.8769	0.7833	0.6465	0.4505	0.3094	0.3258	0.5757	0.8084	0.9143	0.9512 (94)
Useful gains	794.4123	868.2683	938.1028	944.0873	806.9055	577.8801	377.7667	375.9385	604.7726	739.0928	755.6798	752.3228 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W	1699.5809	1668.4202	1518.9557	1268.0455	938.5925	607.3148	383.9248	383.0622	670.6262	1031.4922	1376.4210	1665.9537 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	673.4454	537.7021	432.1545	233.2499	97.9752	0.0000	0.0000	0.0000	0.0000	217.5451	446.9336	679.7414 (98)
Space heating												3318.7472 (98)
RHI space heating demand												3319 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6800	
Infiltration rate			0.3714	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4381	0.4295	0.4209	0.3779	0.3693	0.3264	0.3264	0.3178	0.3436	0.3693	0.3865	0.4037	(22b)
Effective ac	0.5959	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2374	56.8796	56.5288	54.8813	54.5731	53.1382	53.1382	52.8724	53.6909	54.5731	55.1967	55.8486	(38)
Heat transfer coeff	131.2690	130.9111	130.5604	128.9129	128.6046	127.1697	127.1697	126.9040	127.7224	128.6046	129.2282	129.8801	(39)
Average = Sum(39)m / 12 =												128.9114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1673	1.1641	1.1609	1.1463	1.1436	1.1308	1.1308	1.1284	1.1357	1.1436	1.1491	1.1549	(40)
HLP (average)												1.1463	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	804.7167	918.2478	1035.5940	1154.1570	1223.5139	1197.1550	1144.9798	1071.4883	983.8277	866.0835	782.7583	763.3869	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5876	32.6767	32.7645	33.1832	33.2628	33.6381	33.6381	33.7085	33.4925	33.2628	33.1023	32.9361	
alpha	3.1725	3.1784	3.1843	3.2122	3.2175	3.2425	3.2425	3.2472	3.2328	3.2175	3.2068	3.1957	
util living area	0.9733	0.9585	0.9279	0.8625	0.7542	0.6025	0.4629	0.5075	0.7201	0.8964	0.9594	0.9771	(86)
MIT	19.1775	19.4107	19.7920	20.2656	20.6441	20.8790	20.9615	20.9477	20.7745	20.2692	19.6410	19.1359	(87)
Th 2	19.9463	19.9489	19.9514	19.9632	19.9654	19.9758	19.9758	19.9777	19.9718	19.9654	19.9609	19.9562	(88)
util rest of house	0.9682	0.9508	0.9143	0.8362	0.7068	0.5272	0.3650	0.4083	0.6520	0.8706	0.9506	0.9727	(89)
MIT 2	17.5313	17.8687	18.4152	19.0844	19.5873	19.8752	19.9541	19.9460	19.7643	19.1063	18.2130	17.4774	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.0395	18.3448	18.8403	19.4491	19.9136	20.1851	20.2651	20.2553	20.0762	19.4653	18.6539	17.9895	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8895	18.1948	18.6903	19.2991	19.7636	20.0351	20.1151	20.1053	19.9262	19.3153	18.5039	17.8395	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9544	0.9335	0.8935	0.8162	0.6965	0.5318	0.3789	0.4213	0.6486	0.8504	0.9337	0.9602	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	768.0487	857.1909	925.2519	942.0547	852.1269	636.6707	433.8624	451.4532	638.1066	736.5557	730.8878	733.0162	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1783.8850	1740.4346	1591.5662	1340.5771	1037.0136	691.1791	447.0135	470.2121	744.1345	1120.8316	1473.7044	1771.4941	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	755.7823	593.5397	495.7379	286.9361	137.5557	0.0000	0.0000	0.0000	0.0000	285.9012	534.8280	772.6276	(98)
Space heating												3862.9085	(98)
Space heating per m2											(98) / (4) =	34.3492	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4268.4071	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	755.7823	593.5397	495.7379	286.9361	137.5557	0.0000	0.0000	0.0000	0.0000	285.9012	534.8280	772.6276	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	835.1185	655.8450	547.7767	317.0565	151.9953	0.0000	0.0000	0.0000	0.0000	315.9130	590.9701	853.7321	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8677	89.8099	89.6851	89.4062	88.8634	87.3000	87.3000	87.3000	87.3000	89.3766	89.7383	89.8935	(217)
Fuel for water heating, kWh/month	199.7809	175.2804	182.1677	160.7874	156.3137	138.9421	130.3772	147.2980	148.3736	166.9327	179.5872	193.9046	(219)
Water heating fuel used												1979.7456	(219)
Annual totals kWh/year													
Space heating fuel - main system												4268.4071	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5708.8555	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4268.4071	3.4800	148.5406	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.7456	3.4800	68.8951	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			266.3024	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7103	(257)
SAP value		90.0910	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4268.4071	0.2160	921.9759	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.7456	0.2160	427.6250	(264)
Space and water heating			1349.6010	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)

Energy saving/generation technologies			
PV Unit	-1074.8994	0.5190	-557.8728 (269)
Total kg/year			1069.7057 (272)
CO2 emissions per m2			9.5100 (273)
EI value			90.8967
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6800	
Infiltration rate			0.3714	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3006	0.2920	0.3178	0.3006	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5426	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2719	53.4110	53.6909	53.1382	53.1382	52.8724	52.6138	52.3622	52.1178	52.8724	52.3622	52.8724	(38)
Heat transfer coeff	128.3035	127.4425	127.7224	127.1697	127.1697	126.9040	126.6453	126.3938	126.1493	126.9040	126.3938	126.9040	(39)
Average = Sum(39)m / 12 =												127.0085	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1409	1.1332	1.1357	1.1308	1.1308	1.1284	1.1261	1.1239	1.1217	1.1284	1.1239	1.1284	(40)
HLP (average)												1.1294	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	33.3409	33.5661	33.4925	33.6381	33.6381	33.7085	33.7774	33.8446	33.9102	33.7085	33.8446	33.7085	
alpha	3.2227	3.2377	3.2328	3.2425	3.2425	3.2472	3.2518	3.2563	3.2607	3.2472	3.2563	3.2472	
util living area	0.9665	0.9524	0.9139	0.8322	0.7067	0.5219	0.3915	0.4115	0.6499	0.8606	0.9450	0.9709	(86)
MIT	19.3670	19.5535	19.9423	20.3996	20.7401	20.9296	20.9793	20.9762	20.8532	20.4357	19.8545	19.3488	(87)
Th 2	19.9676	19.9738	19.9718	19.9758	19.9758	19.9777	19.9795	19.9814	19.9831	19.9777	19.9814	19.9777	(88)
util rest of house	0.9602	0.9436	0.8978	0.8010	0.6521	0.4416	0.2945	0.3105	0.5730	0.8264	0.9329	0.9653	(89)
MIT 2	17.8185	18.0896	18.6408	19.2737	19.7138	19.9257	19.9699	19.9701	19.8593	19.3398	18.5315	17.7993	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2966	18.5416	19.0426	19.6213	20.0306	20.2356	20.2815	20.2807	20.1661	19.6781	18.9399	18.2777	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1466	18.3916	18.8926	19.4713	19.8806	20.0856	20.1315	20.1307	20.0161	19.5281	18.7899	18.1277	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9257	0.8769	0.7833	0.6465	0.4505	0.3094	0.3258	0.5757	0.8084	0.9143	0.9512	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Useful gains	794.4123	868.2683	938.1028	944.0873	806.9055	577.8801	377.7667	375.9385	604.7726	739.0928	755.6798	752.3228	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1699.5809	1668.4202	1518.9557	1268.0455	938.5925	607.3148	383.9248	383.0622	670.6262	1031.4922	1376.4210	1665.9537	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	673.4454	537.7021	432.1545	233.2499	97.9752	0.0000	0.0000	0.0000	0.0000	217.5451	446.9336	679.7414	(98)
Space heating												3318.7472	(98)
Space heating per m2											(98) / (4) =	29.5105	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3667.1240	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	673.4454	537.7021	432.1545	233.2499	97.9752	0.0000	0.0000	0.0000	0.0000	217.5451	446.9336	679.7414	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	744.1386	594.1459	477.5188	257.7347	108.2599	0.0000	0.0000	0.0000	0.0000	240.3814	493.8493	751.0955	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8071	89.7549	89.5990	89.2525	88.5957	87.3000	87.3000	87.3000	87.3000	89.1703	89.6293	89.8280	(217)
Fuel for water heating, kWh/month	199.9157	175.3878	182.3428	161.0641	156.7860	138.9421	130.3772	147.2980	148.3736	167.3190	179.8057	194.0459	(219)
Water heating fuel used												1981.6579	(219)
Annual totals kWh/year													
Space heating fuel - main system												3667.1240	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4963.6595	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3667.1240	10.2300	375.1468	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.6579	10.2300	202.7236	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			429.2934	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3667.1240	0.2160	792.0988	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6579	0.2160	428.0381	(264)
Space and water heating			1220.1369	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			864.5583	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy	Primary energy factor	Primary energy	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	kWh/year	kg CO2/kWh	kWh/year	
Space heating - main system 1	3667.1240	1.2200	4473.8913	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6579	1.2200	2417.6226	(264)
Space and water heating			6891.5139	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			4788.1880	(272)
Primary energy kWh/m2/year			42.5768	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (22.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	B 91	A 92
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£681	£576	£105
Space heating	£506	£506	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£448	-£448	£0
Total cost of fuels	£430	£343	£87
Total cost of uses	£430	£343	£87
Delivered energy	44 kWh/m²	35 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	33 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6800	
Infiltration rate			0.3714	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4381	0.4295	0.4209	0.3779	0.3693	0.3264	0.3264	0.3178	0.3436	0.3693	0.3865	0.4037	(22b)
Effective ac	0.5959	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	74.0315	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2374	56.8796	56.5288	54.8813	54.5731	53.1382	53.1382	52.8724	53.6909	54.5731	55.1967	55.8486	(38)
Heat transfer coeff	131.2690	130.9111	130.5604	128.9129	128.6046	127.1697	127.1697	126.9040	127.7224	128.6046	129.2282	129.8801	(39)
Average = Sum(39)m / 12 =												128.9114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1673	1.1641	1.1609	1.1463	1.1436	1.1308	1.1308	1.1284	1.1357	1.1436	1.1491	1.1549	(40)
HLP (average)												1.1463	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
								Solar input (sum of months) = Sum(63)m =				-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
								Total per year (kWh/year) = Sum(64)m =				886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	804.7167	918.2478	1035.5940	1154.1570	1223.5139	1197.1550	1144.9798	1071.4883	983.8277	866.0835	782.7583	763.3869	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	32.5876	32.6767	32.7645	33.1832	33.2628	33.6381	33.6381	33.7085	33.4925	33.2628	33.1023	32.9361	
alpha	3.1725	3.1784	3.1843	3.2122	3.2175	3.2425	3.2425	3.2472	3.2328	3.2175	3.2068	3.1957	
util living area	0.9733	0.9585	0.9279	0.8625	0.7542	0.6025	0.4629	0.5075	0.7201	0.8964	0.9594	0.9771	(86)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	19.1775	19.4107	19.7920	20.2656	20.6441	20.8790	20.9615	20.9477	20.7745	20.2692	19.6410	19.1359 (87)
Th 2	19.9463	19.9489	19.9514	19.9632	19.9654	19.9758	19.9758	19.9777	19.9718	19.9654	19.9609	19.9562 (88)
util rest of house	0.9682	0.9508	0.9143	0.8362	0.7068	0.5272	0.3650	0.4083	0.6520	0.8706	0.9506	0.9727 (89)
MIT 2	17.5313	17.8687	18.4152	19.0844	19.5873	19.8752	19.9541	19.9460	19.7643	19.1063	18.2130	17.4774 (90)
Living area fraction									fLA = Living area / (4) =			0.3087 (91)
MIT	18.0395	18.3448	18.8403	19.4491	19.9136	20.1851	20.2651	20.2553	20.0762	19.4653	18.6539	17.9895 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8895	18.1948	18.6903	19.2991	19.7636	20.0351	20.1151	20.1053	19.9262	19.3153	18.5039	17.8395 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9544	0.9335	0.8935	0.8162	0.6965	0.5318	0.3789	0.4213	0.6486	0.8504	0.9337	0.9602	(94)
Useful gains	768.0487	857.1909	925.2519	942.0547	852.1269	636.6707	433.8624	451.4532	638.1066	736.5557	730.8878	733.0162	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1783.8850	1740.4346	1591.5662	1340.5771	1037.0136	691.1791	447.0135	470.2121	744.1345	1120.8316	1473.7044	1771.4941	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	755.7823	593.5397	495.7379	286.9361	137.5557	0.0000	0.0000	0.0000	0.0000	285.9012	534.8280	772.6276	(98)
Space heating												3862.9085	(98)
Space heating per m2											(98) / (4) =	34.3492	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4268.4071	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	755.7823	593.5397	495.7379	286.9361	137.5557	0.0000	0.0000	0.0000	0.0000	285.9012	534.8280	772.6276	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	835.1185	655.8450	547.7767	317.0565	151.9953	0.0000	0.0000	0.0000	0.0000	315.9130	590.9701	853.7321	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9416	89.9648	89.9878	90.0362	90.0940	87.3000	87.3000	87.3000	87.3000	89.6803	89.8520	89.9549	(217)
Fuel for water heating, kWh/month	171.3510	127.8235	101.2647	52.1154	21.3987	4.2204	0.0000	31.1465	57.4037	105.8944	145.7994	170.1221	(219)
Water heating fuel used												988.5399	(219)
Annual totals kWh/year													
Space heating fuel - main system												4268.4071	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4767.6499	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4268.4071	3.4800	148.5406	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.5399	3.4800	34.4012	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			238.4035	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6359	(257)
SAP value		91.1291	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4268.4071	0.2160	921.9759	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.5399	0.2160	213.5246	(264)
Space and water heating			1135.5006	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			881.5553	(272)
CO2 emissions per m2			7.8400	(273)
EI value			92.4979	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6800	
Infiltration rate			0.3714	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3006	0.2920	0.3178	0.3006	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5426	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	108.3200	16.2300	92.0900	0.2500	23.0225	52.1000	4797.8890	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9038			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	15399.8890			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					136.9366			(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					13.1278			(36)
Total fabric heat loss				(33) + (36) =	74.0315			(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2719	53.4110	53.6909	53.1382	53.1382	52.8724	52.6138	52.3622	52.1178	52.8724	52.3622	52.8724	(38)
Heat transfer coeff	128.3035	127.4425	127.7224	127.1697	127.1697	126.9040	126.6453	126.3938	126.1493	126.9040	126.3938	126.9040	(39)
Average = Sum(39)m / 12 =												127.0085	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1409	1.1332	1.1357	1.1308	1.1308	1.1284	1.1261	1.1239	1.1217	1.1284	1.1239	1.1284	(40)
HLP (average)												1.1294	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
										Solar input (sum of months) = Sum(63)m =		-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
										Total per year (kWh/year) = Sum(64)m =		856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3409	33.5661	33.4925	33.6381	33.6381	33.7085	33.7774	33.8446	33.9102	33.7085	33.8446	33.7085	
alpha	3.2227	3.2377	3.2328	3.2425	3.2425	3.2472	3.2518	3.2563	3.2607	3.2472	3.2563	3.2472	
util living area	0.9665	0.9524	0.9139	0.8322	0.7067	0.5219	0.3915	0.4115	0.6499	0.8606	0.9450	0.9709	(86)

MIT	19.3670	19.5535	19.9423	20.3996	20.7401	20.9296	20.9793	20.9762	20.8532	20.4357	19.8545	19.3488 (87)
Th 2	19.9676	19.9738	19.9718	19.9758	19.9758	19.9777	19.9795	19.9814	19.9831	19.9777	19.9814	19.9777 (88)
util rest of house	0.9602	0.9436	0.8978	0.8010	0.6521	0.4416	0.2945	0.3105	0.5730	0.8264	0.9329	0.9653 (89)
MIT 2	17.8185	18.0896	18.6408	19.2737	19.7138	19.9257	19.9699	19.9701	19.8593	19.3398	18.5315	17.7993 (90)
Living area fraction										fLA = Living area / (4) =		0.3087 (91)
MIT	18.2966	18.5416	19.0426	19.6213	20.0306	20.2356	20.2815	20.2807	20.1661	19.6781	18.9399	18.2777 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1466	18.3916	18.8926	19.4713	19.8806	20.0856	20.1315	20.1307	20.0161	19.5281	18.7899	18.1277 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9257	0.8769	0.7833	0.6465	0.4505	0.3094	0.3258	0.5757	0.8084	0.9143	0.9512	(94)
Useful gains	794.4123	868.2683	938.1028	944.0873	806.9055	577.8801	377.7667	375.9385	604.7726	739.0928	755.6798	752.3228	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1699.5809	1668.4202	1518.9557	1268.0455	938.5925	607.3148	383.9248	383.0622	670.6262	1031.4922	1376.4210	1665.9537	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	673.4454	537.7021	432.1545	233.2499	97.9752	0.0000	0.0000	0.0000	0.0000	217.5451	446.9336	679.7414	(98)
Space heating												3318.7472	(98)
Space heating per m2											(98) / (4) =	29.5105	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3667.1240	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	673.4454	537.7021	432.1545	233.2499	97.9752	0.0000	0.0000	0.0000	0.0000	217.5451	446.9336	679.7414	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	744.1386	594.1459	477.5188	257.7347	108.2599	0.0000	0.0000	0.0000	0.0000	240.3814	493.8493	751.0955	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9005	89.9190	89.9287	89.9612	89.8613	87.3000	87.3000	87.3000	87.3000	89.5338	89.7766	89.9048	(217)
Fuel for water heating, kWh/month	166.5834	127.9764	100.7442	50.6413	26.2274	0.0000	0.0000	23.6468	51.5633	101.3781	140.2790	166.6433	(219)
Water heating fuel used												955.6831	(219)
Annual totals kWh/year													
Space heating fuel - main system												3667.1240	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3987.6847	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3667.1240	10.2300	375.1468	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.6831	10.2300	97.7664	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			342.6962	(255)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3667.1240	0.2160	792.0988	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.6831	0.2160	206.4275	(264)
Space and water heating			998.5263	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			668.8978	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3667.1240	1.2200	4473.8913	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.6831	1.2200	1165.9334	(264)
Space and water heating			5639.8247	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3689.9988	(272)
Primary energy kWh/m2/year			32.8117	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	74.03	(37)
Summer heat loss coefficient	458.21	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
East	1.000	1.00	1.000	1.000	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	2.1700	117.5071	0.4600	0.0000	0.9000	105.5660
South	2.1600	112.2060	0.4600	0.0000	0.9000	100.3391
West	5.8100	117.5071	0.4600	0.0000	0.9000	282.6445
East	5.4600	117.5071	0.4600	0.0000	0.9000	265.6177
East	0.6500	176.6135	0.6300	0.7000	1.0000	45.5636
total:						799.7309

	Jun	Jul	Aug	
Solar gains	847	800	714	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1360	1292	1215	(P5)
Summer gain/loss ratio	2.97	2.82	2.65	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	20.01	21.76	21.49	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-305	**Issued on Date**	01/08/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-As-SEMI
Property	5, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	11.17	**TER**	17.47
Environmental	91 B	**% DER<TER**	36.05		
CO_2 Emissions (t/year)	0.89	**DFEE**	47.60	**TFEE**	55.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.00		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.47 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.17 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.67 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.16 m², No overhang
Windows facing East: 7.63 m², No overhang
Windows facing West: 5.81 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3709	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4375	0.4289	0.4203	0.3774	0.3689	0.3260	0.3260	0.3174	0.3431	0.3689	0.3860	0.4032	(22b)
Effective ac	0.5957	0.5920	0.5883	0.5712	0.5680	0.5531	0.5531	0.5504	0.5589	0.5680	0.5745	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2126	56.8558	56.5059	54.8629	54.5555	53.1244	53.1244	52.8594	53.6756	54.5555	55.1774	55.8275	(38)
Heat transfer coeff	131.0777	130.7208	130.3710	128.7279	128.4205	126.9894	126.9894	126.7244	127.5407	128.4205	129.0424	129.6925	(39)
Average = Sum(39)m / 12 =												128.7264	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1655	1.1624	1.1593	1.1447	1.1419	1.1292	1.1292	1.1268	1.1341	1.1419	1.1475	1.1532	(40)
HLP (average)												1.1446	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	556.5463	657.6463	779.8545	919.1233	1014.5828	1007.0013	957.5946	871.7144	762.7598	632.1186	546.1872	523.6144	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6352	32.7243	32.8121	33.2309	33.3105	33.6859	33.6859	33.7563	33.5403	33.3105	33.1499	32.9838	
alpha	3.1757	3.1816	3.1875	3.2154	3.2207	3.2457	3.2457	3.2504	3.2360	3.2207	3.2100	3.1989	
util living area	0.9903	0.9829	0.9642	0.9157	0.8211	0.6771	0.5364	0.5956	0.8154	0.9506	0.9846	0.9920	(86)
MIT	18.8805	19.1112	19.5241	20.0680	20.5294	20.8289	20.9411	20.9166	20.6630	20.0428	19.3664	18.8451	(87)
Th 2	19.9477	19.9502	19.9527	19.9645	19.9667	19.9771	19.9771	19.9790	19.9731	19.9667	19.9623	19.9576	(88)
util rest of house	0.9884	0.9794	0.9566	0.8970	0.7801	0.6015	0.4290	0.4885	0.7570	0.9360	0.9809	0.9904	(89)
MIT 2	17.1027	17.4398	18.0391	18.8208	19.4512	19.8294	19.9425	19.9258	19.6448	18.8005	17.8208	17.0569	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6515	17.9558	18.4975	19.2059	19.7841	20.1380	20.2508	20.2317	19.9591	19.1840	18.2980	17.6090	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5015	17.8058	18.3475	19.0559	19.6341	19.9880	20.1008	20.0817	19.8091	19.0340	18.1480	17.4590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9813	0.9689	0.9405	0.8763	0.7647	0.6024	0.4428	0.5001	0.7459	0.9181	0.9711	0.9844	(94)
Useful gains	546.1640	637.2165	733.4834	805.4732	775.8409	606.6082	424.0359	435.9855	568.9376	580.3247	530.4203	515.4428	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1730.4241	1687.0590	1544.5740	1307.3418	1018.8993	684.2135	444.5615	466.5609	728.1456	1083.1013	1425.6568	1719.5892	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	881.0895	705.4942	603.4514	361.3454	180.8354	0.0000	0.0000	0.0000	0.0000	374.0658	644.5702	895.8849	(98)
Space heating												4646.7368	(98)
Space heating per m2											(98) / (4) =	41.3190	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5134.5158	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	881.0895	705.4942	603.4514	361.3454	180.8354	0.0000	0.0000	0.0000	0.0000	374.0658	644.5702	895.8849	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	973.5796	779.5516	666.7971	399.2767	199.8181	0.0000	0.0000	0.0000	0.0000	413.3324	712.2323	989.9281	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9419	89.8989	89.7987	89.5656	89.0815	87.3000	87.3000	87.3000	87.3000	89.5639	89.8413	89.9629	(217)
Fuel for water heating, kWh/month	199.6160	175.1070	181.9373	160.5011	155.9311	138.9421	130.3772	147.2980	148.3736	166.5836	179.3814	193.7549	(219)
Water heating fuel used												1977.8032	(219)
Annual totals kWh/year													
Space heating fuel - main system												5134.5158	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6573.0218	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5134.5158	0.2160	1109.0554	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.8032	0.2160	427.2055	(264)
Space and water heating			1536.2609	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1256.3657	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.1700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.1700	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		27.3246	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.3246	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	94.3798	184.6076	305.4859	450.1283	557.2098	573.2108	544.5435	463.7732	356.5842	219.3014	117.6404	77.6591	(83)
Total gains	554.9725	642.7963	747.2931	865.3256	944.4912	933.9277	888.7122	815.2806	722.6429	612.2016	541.1968	524.5088	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9992	0.9981	0.9940	0.9751	0.9098	0.7586	0.5884	0.6560	0.8990	0.9890	0.9983	0.9994	(86)
MIT	19.6874	19.8287	20.0876	20.4431	20.7519	20.9362	20.9864	20.9769	20.8315	20.4232	19.9957	19.6693	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9989	0.9975	0.9917	0.9649	0.8725	0.6710	0.4652	0.5314	0.8420	0.9830	0.9976	0.9992	(89)
MIT 2	18.2139	18.4226	18.8021	19.3233	19.7447	19.9650	20.0043	20.0015	19.8587	19.3022	18.6766	18.1953	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9964	0.9892	0.9607	0.8750	0.6955	0.5036	0.5700	0.8525	0.9801	0.9967	0.9988	(94)
Useful gains	554.0795	640.4658	739.2284	831.2766	826.4254	649.5287	447.5473	464.7420	616.0288	599.9989	539.3937	523.8811	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1824.3551	1766.5985	1602.5501	1339.6995	1036.6664	693.9811	454.1940	476.9681	745.9130	1122.5917	1494.9370	1812.8701	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	945.0850	756.7612	642.3113	366.0645	156.4193	0.0000	0.0000	0.0000	0.0000	388.8090	687.9912	959.0078	(98)
Space heating												4902.4494	(98)
Space heating per m2											(98) / (4) =	43.5928	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5248.8752	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	945.0850	756.7612	642.3113	366.0645	156.4193	0.0000	0.0000	0.0000	0.0000	388.8090	687.9912	959.0078	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1011.8683	810.2368	687.6995	391.9321	167.4725	0.0000	0.0000	0.0000	0.0000	416.2837	736.6073	1026.7750	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3305	88.1682	87.7763	86.8124	84.7925	80.3000	80.3000	80.3000	80.3000	86.8637	87.9397	88.3940	(217)
Fuel for water heating, kWh/month													
	244.9255	216.2619	228.1041	206.3397	204.5322	190.2188	182.2441	203.1594	205.4031	214.2172	223.7975	238.8460	(219)
Water heating fuel used												2558.0495	(219)
Annual totals kWh/year													
Space heating fuel - main system												5248.8752	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8342.5268	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5248.8752	0.2160	1133.7570	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2558.0495	0.2160	552.5387	(264)
Space and water heating			1686.2957	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1964.2733	(272)
Emissions per m2 for space and water heating			14.9946	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9946 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.4700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3709	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4375	0.4289	0.4203	0.3774	0.3689	0.3260	0.3260	0.3174	0.3431	0.3689	0.3860	0.4032	(22b)
Effective ac	0.5957	0.5920	0.5883	0.5712	0.5680	0.5531	0.5531	0.5504	0.5589	0.5680	0.5745	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2126	56.8558	56.5059	54.8629	54.5555	53.1244	53.1244	52.8594	53.6756	54.5555	55.1774	55.8275	(38)
Heat transfer coeff	131.0777	130.7208	130.3710	128.7279	128.4205	126.9894	126.9894	126.7244	127.5407	128.4205	129.0424	129.6925	(39)
Average = Sum(39)m / 12 =												128.7264	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1655	1.1624	1.1593	1.1447	1.1419	1.1292	1.1292	1.1268	1.1341	1.1419	1.1475	1.1532	(40)
HLP (average)												1.1446	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	522.1154	624.0649	748.0371	889.7046	986.7251	981.3389	933.7947	845.5244	735.7179	602.5939	513.8598	490.0294	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0890	32.1766	32.2629	32.6747	32.7529	33.1220	33.1220	33.1913	32.9789	32.7529	32.5951	32.4317	
alpha	3.1393	3.1451	3.1509	3.1783	3.1835	3.2081	3.2081	3.2128	3.1986	3.1835	3.1730	3.1621	
util living area	0.9915	0.9845	0.9667	0.9200	0.8280	0.6863	0.5461	0.6075	0.8251	0.9548	0.9864	0.9931	(86)
MIT	18.8126	19.0478	19.4696	20.0268	20.5028	20.8158	20.9354	20.9083	20.6394	19.9983	19.3070	18.7774	(87)
Th 2	19.9477	19.9502	19.9527	19.9645	19.9667	19.9771	19.9771	19.9790	19.9731	19.9667	19.9623	19.9576	(88)
util rest of house	0.9898	0.9814	0.9597	0.9022	0.7880	0.6113	0.4380	0.5002	0.7686	0.9415	0.9831	0.9917	(89)
MIT 2	17.9396	18.1753	18.5944	19.1460	19.5924	19.8674	19.9508	19.9384	19.7307	19.1293	18.4433	17.9117	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.2091	18.4446	18.8646	19.4180	19.8735	20.1602	20.2548	20.2379	20.0112	19.3976	18.7100	18.1789	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2091	18.4446	18.8646	19.4180	19.8735	20.1602	20.2548	20.2379	20.0112	19.3976	18.7100	18.1789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9753	0.9502	0.8908	0.7839	0.6259	0.4690	0.5294	0.7710	0.9320	0.9777	0.9883	(94)
Useful gains	514.7213	608.6504	710.8193	792.5875	773.5280	614.2071	437.9579	447.6276	567.2751	561.6218	502.4077	484.2929	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1823.1718	1770.5673	1611.9850	1353.9563	1049.6434	706.0885	464.1190	486.3501	753.9209	1129.7879	1498.1767	1812.9640	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	973.4871	780.8082	670.4673	404.1856	205.4298	0.0000	0.0000	0.0000	0.0000	422.7156	716.9537	988.5313 (98)
Space heating												5162.5787 (98)
Space heating per m2											(98) / (4) =	45.9059 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1193.7006	939.7218	963.1055	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7801	0.8444	0.8088	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	931.1598	793.5184	778.9383	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1251.4879	1193.9056	1094.1190	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	230.6362	297.8881	234.4944	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												763.0188	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.6591	74.4720	58.6236	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												190.7547	(107)
Space cooling per m2												1.6962	(108)
Energy for space heating												45.9059	(99)
Energy for space cooling												1.6962	(108)
Total												47.6021	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288 (42)
Average daily hot water use (litres/day)	101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	94.3798	184.6076	305.4859	450.1283	557.2098	573.2108	544.5435	463.7732	356.5842	219.3014	117.6404	77.6591	(83)
Total gains	508.1742	596.8433	703.0952	823.6240	905.0332	897.3454	853.9840	777.4824	683.3063	570.2851	496.4915	478.5522	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9995	0.9987	0.9954	0.9796	0.9215	0.7784	0.6092	0.6812	0.9156	0.9919	0.9989	0.9996	(86)
MIT	19.6483	19.7905	20.0516	20.4121	20.7306	20.9278	20.9841	20.9725	20.8112	20.3897	19.9584	19.6308	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9993	0.9982	0.9936	0.9711	0.8875	0.6922	0.4832	0.5549	0.8643	0.9874	0.9984	0.9995	(89)
MIT 2	18.7343	18.8786	19.1411	19.5071	19.8076	19.9745	20.0053	20.0032	19.8901	19.4904	19.0571	18.7256	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9977	0.9923	0.9688	0.8912	0.7168	0.5226	0.5944	0.8748	0.9860	0.9980	0.9993	(94)
Useful gains	507.6911	595.4486	697.7030	797.9541	806.6087	643.2597	446.3100	462.1464	597.7612	562.3087	495.4867	478.2230	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1868.4932	1805.0048	1630.7129	1354.3062	1041.2410	694.4617	454.1893	476.9464	747.8133	1137.4531	1526.3118	1857.3673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1012.4368	812.8217	694.1593	400.5736	174.5664	0.0000	0.0000	0.0000	0.0000	427.9074	742.1941	1026.0833	(98)
Space heating												5290.7427	(98)
Space heating per m2											(98) / (4) =	47.0456	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8406	0.9093	0.8749	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	968.0437	824.3662	812.6648	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1153.3137	1100.6204	1014.5894	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	133.3944	205.5331	150.2319	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												489.1594	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	33.3486	51.3833	37.5580	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												122.2898	(107)
Space cooling per m2												1.0874	(108)
Energy for space heating												47.0456	(99)
Energy for space cooling												1.0874	(108)
Total												48.1330	(109)
Target Fabric Energy Efficiency (TFEE)												55.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3709	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3603	0.3345	0.3431	0.3260	0.3260	0.3174	0.3088	0.3002	0.2916	0.3174	0.3002	0.3174	(22b)
Effective ac	0.5649	0.5560	0.5589	0.5531	0.5531	0.5504	0.5477	0.5451	0.5425	0.5504	0.5451	0.5504	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2551	53.3965	53.6756	53.1244	53.1244	52.8594	52.6014	52.3506	52.1067	52.8594	52.3506	52.8594	(38)
Heat transfer coeff	128.1201	127.2615	127.5407	126.9894	126.9894	126.7244	126.4665	126.2156	125.9718	126.7244	126.2156	126.7244	(39)
Average = Sum(39)m / 12 =												126.8287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1393	1.1316	1.1341	1.1292	1.1292	1.1268	1.1245	1.1223	1.1201	1.1268	1.1223	1.1268	(40)
HLP (average)												1.1278	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)
Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3886	33.6138	33.5403	33.6859	33.6859	33.7563	33.8251	33.8924	33.9580	33.7563	33.8924	33.7563	
alpha	3.2259	3.2409	3.2360	3.2457	3.2457	3.2504	3.2550	3.2595	3.2639	3.2504	3.2595	3.2504	
util living area													
	0.9699	0.9577	0.9224	0.8426	0.7154	0.5287	0.3981	0.4224	0.6696	0.8751	0.9512	0.9736	(86)
MIT	19.3319	19.5089	19.8995	20.3738	20.7308	20.9272	20.9783	20.9744	20.8398	20.3998	19.8158	19.3183	(87)
Th 2	19.9689	19.9751	19.9731	19.9771	19.9771	19.9790	19.9808	19.9827	19.9844	19.9790	19.9827	19.9790	(88)
util rest of house													
	0.9641	0.9498	0.9076	0.8125	0.6612	0.4479	0.2999	0.3195	0.5929	0.8432	0.9402	0.9685	(89)
MIT 2	17.7691	18.0272	18.5827	19.2417	19.7047	19.9250	19.9707	19.9704	19.8478	19.2951	18.4780	17.7564	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2516	18.4847	18.9892	19.5912	20.0215	20.2344	20.2818	20.2804	20.1540	19.6361	18.8910	18.2386	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1016	18.3347	18.8392	19.4412	19.8715	20.0844	20.1318	20.1304	20.0040	19.4861	18.7410	18.0886	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9328	0.8870	0.7942	0.6550	0.4566	0.3149	0.3349	0.5945	0.8246	0.9224	0.9552	(94)
Useful gains	766.9777	834.5343	906.5255	925.1613	799.7677	575.8192	376.9617	374.7947	596.1458	714.1135	726.8331	728.2399	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1691.3910	1658.8105	1509.9853	1262.4261	936.0965	606.2996	383.4158	382.4831	668.1581	1024.7125	1368.3053	1658.6465	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	687.7634	553.9136	448.9741	242.8307	101.4287	0.0000	0.0000	0.0000	0.0000	231.0857	461.8600	692.2225	(98)
Space heating												3420.0786	(98)
RHI space heating demand												3420	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3709	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4375	0.4289	0.4203	0.3774	0.3689	0.3260	0.3260	0.3174	0.3431	0.3689	0.3860	0.4032	(22b)
Effective ac	0.5957	0.5920	0.5883	0.5712	0.5680	0.5531	0.5531	0.5504	0.5589	0.5680	0.5745	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2126	56.8558	56.5059	54.8629	54.5555	53.1244	53.1244	52.8594	53.6756	54.5555	55.1774	55.8275	(38)
Heat transfer coeff	131.0777	130.7208	130.3710	128.7279	128.4205	126.9894	126.9894	126.7244	127.5407	128.4205	129.0424	129.6925	(39)
Average = Sum(39)m / 12 =												128.7264	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1655	1.1624	1.1593	1.1447	1.1419	1.1292	1.1292	1.1268	1.1341	1.1419	1.1475	1.1532	(40)
HLP (average)												1.1446	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	777.0833	875.2149	987.3917	1112.2541	1192.7922	1173.7726	1119.4759	1036.5642	937.6410	821.4062	750.3962	739.2614	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6352	32.7243	32.8121	33.2309	33.3105	33.6859	33.6859	33.7563	33.5403	33.3105	33.1499	32.9838	
alpha	3.1757	3.1816	3.1875	3.2154	3.2207	3.2457	3.2457	3.2504	3.2360	3.2207	3.2100	3.1989	
util living area	0.9756	0.9632	0.9355	0.8723	0.7636	0.6106	0.4715	0.5209	0.7392	0.9077	0.9636	0.9790	(86)
MIT	19.1483	19.3659	19.7468	20.2353	20.6306	20.8745	20.9595	20.9437	20.7559	20.2314	19.6074	19.1103	(87)
Th 2	19.9477	19.9502	19.9527	19.9645	19.9667	19.9771	19.9771	19.9790	19.9731	19.9667	19.9623	19.9576	(88)
util rest of house	0.9710	0.9563	0.9230	0.8472	0.7169	0.5351	0.3724	0.4203	0.6723	0.8840	0.9556	0.9750	(89)
MIT 2	17.4902	17.8057	18.3531	19.0455	19.5726	19.8723	19.9542	19.9447	19.7461	19.0570	18.1662	17.4414	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0021	18.2874	18.7834	19.4128	19.8993	20.1817	20.2646	20.2531	20.0578	19.4195	18.6112	17.9567	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8521	18.1374	18.6334	19.2628	19.7493	20.0317	20.1146	20.1031	19.9078	19.2695	18.4612	17.8067	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9579	0.9400	0.9028	0.8269	0.7059	0.5395	0.3863	0.4332	0.6675	0.8638	0.9395	0.9631	(94)
Useful gains	744.4008	822.7303	891.4437	919.7386	841.9707	633.1977	432.4655	449.0359	625.8747	709.5271	705.0147	711.9929	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1776.3820	1730.4066	1581.8388	1333.9869	1033.6914	689.7702	446.3113	469.2737	740.7367	1113.3477	1466.0723	1764.6825	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	767.7940	609.9584	513.6539	298.2588	142.6402	0.0000	0.0000	0.0000	0.0000	300.4425	547.9614	783.2011	(98)
Space heating												3963.9104	(98)
Space heating per m2											(98) / (4) =	35.2473	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4380.0115	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	767.7940	609.9584	513.6539	298.2588	142.6402	0.0000	0.0000	0.0000	0.0000	300.4425	547.9614	783.2011	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	848.3912	673.9872	567.5734	329.5677	157.6135	0.0000	0.0000	0.0000	0.0000	331.9807	605.4823	865.4156	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8756	89.8246	89.7065	89.4338	88.8924	87.3000	87.3000	87.3000	87.3000	89.4125	89.7523	89.9001	(217)
Fuel for water heating, kWh/month	199.7632	175.2518	182.1243	160.7376	156.2626	138.9421	130.3772	147.2980	148.3736	166.8657	179.5592	193.8902	(219)
Water heating fuel used												1979.4457	(219)
Annual totals kWh/year													
Space heating fuel - main system												4380.0115	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5820.1599	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4380.0115	3.4800	152.4244	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4457	3.4800	68.8847	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			270.1758	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7207	(257)
SAP value		89.9469	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4380.0115	0.2160	946.0825	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4457	0.2160	427.5603	(264)
Space and water heating			1373.6427	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy for lighting	460.6022	0.5190	239.0525 (268)
Energy saving/generation technologies			
PV Unit	-1074.8994	0.5190	-557.8728 (269)
Total kg/year			1093.7475 (272)
CO2 emissions per m2			9.7300 (273)
EI value			90.6921
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6700	
Infiltration rate			0.3709	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3603	0.3345	0.3431	0.3260	0.3260	0.3174	0.3088	0.3002	0.2916	0.3174	0.3002	0.3174	(22b)
Effective ac	0.5649	0.5560	0.5589	0.5531	0.5531	0.5504	0.5477	0.5451	0.5425	0.5504	0.5451	0.5504	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2551	53.3965	53.6756	53.1244	53.1244	52.8594	52.6014	52.3506	52.1067	52.8594	52.3506	52.8594	(38)
Heat transfer coeff	128.1201	127.2615	127.5407	126.9894	126.9894	126.7244	126.4665	126.2156	125.9718	126.7244	126.2156	126.7244	(39)
Average = Sum(39)m / 12 =												126.8287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1393	1.1316	1.1341	1.1292	1.1292	1.1268	1.1245	1.1223	1.1201	1.1268	1.1223	1.1268	(40)
HLP (average)												1.1278	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3886	33.6138	33.5403	33.6859	33.6859	33.7563	33.8251	33.8924	33.9580	33.7563	33.8924	33.7563	
alpha	3.2259	3.2409	3.2360	3.2457	3.2457	3.2504	3.2550	3.2595	3.2639	3.2504	3.2595	3.2504	
util living area	0.9699	0.9577	0.9224	0.8426	0.7154	0.5287	0.3981	0.4224	0.6696	0.8751	0.9512	0.9736	(86)
MIT	19.3319	19.5089	19.8995	20.3738	20.7308	20.9272	20.9783	20.9744	20.8398	20.3998	19.8158	19.3183	(87)
Th 2	19.9689	19.9751	19.9731	19.9771	19.9771	19.9790	19.9808	19.9827	19.9844	19.9790	19.9827	19.9790	(88)
util rest of house	0.9641	0.9498	0.9076	0.8125	0.6612	0.4479	0.2999	0.3195	0.5929	0.8432	0.9402	0.9685	(89)
MIT 2	17.7691	18.0272	18.5827	19.2417	19.7047	19.9250	19.9707	19.9704	19.8478	19.2951	18.4780	17.7564	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2516	18.4847	18.9892	19.5912	20.0215	20.2344	20.2818	20.2804	20.1540	19.6361	18.8910	18.2386	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1016	18.3347	18.8392	19.4412	19.8715	20.0844	20.1318	20.1304	20.0040	19.4861	18.7410	18.0886	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9496	0.9328	0.8870	0.7942	0.6550	0.4566	0.3149	0.3349	0.5945	0.8246	0.9224	0.9552	(94)
Useful gains	766.9777	834.5343	906.5255	925.1613	799.7677	575.8192	376.9617	374.7947	596.1458	714.1135	726.8331	728.2399	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1691.3910	1658.8105	1509.9853	1262.4261	936.0965	606.2996	383.4158	382.4831	668.1581	1024.7125	1368.3053	1658.6465	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.7634	553.9136	448.9741	242.8307	101.4287	0.0000	0.0000	0.0000	0.0000	231.0857	461.8600	692.2225	(98)
Space heating												3420.0786	(98)
Space heating per m2											(98) / (4) =	30.4115	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3779.0924	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.7634	553.9136	448.9741	242.8307	101.4287	0.0000	0.0000	0.0000	0.0000	231.0857	461.8600	692.2225	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.9596	612.0592	496.1040	268.3212	112.0759	0.0000	0.0000	0.0000	0.0000	255.3433	510.3425	764.8868	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8185	89.7718	89.6235	89.2830	88.6225	87.3000	87.3000	87.3000	87.3000	89.2170	89.6500	89.8376	(217)
Fuel for water heating, kWh/month	199.8904	175.3549	182.2929	161.0091	156.7386	138.9421	130.3772	147.2980	148.3736	167.2314	179.7643	194.0251	(219)
Water heating fuel used												1981.2977	(219)
Annual totals kWh/year													
Space heating fuel - main system												3779.0924	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												5075.2676	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3779.0924	10.2300	386.6011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.2977	10.2300	202.6868	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			440.7109	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3779.0924	0.2160	816.2840	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.2977	0.2160	427.9603	(264)
Space and water heating			1244.2443	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			888.6657	(272)

13a. Primary energy - Individual heating systems including micro-CHP

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3779.0924	1.2200	4610.4927	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.2977	1.2200	2417.1832	(264)
Space and water heating			7027.6759	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			4924.3500	(272)
Primary energy kWh/m2/year			43.7876	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (22.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	B 91	A 92
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£692	£587	£105
Space heating	£517	£517	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£448	-£448	£0
Total cost of fuels	£441	£354	£87
Total cost of uses	£441	£354	£87
Delivered energy	45 kWh/m²	36 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	44 kWh/m²	34 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6700	
Infiltration rate			0.3709	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4375	0.4289	0.4203	0.3774	0.3689	0.3260	0.3260	0.3174	0.3431	0.3689	0.3860	0.4032	(22b)
Effective ac	0.5957	0.5920	0.5883	0.5712	0.5680	0.5531	0.5531	0.5504	0.5589	0.5680	0.5745	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2126	56.8558	56.5059	54.8629	54.5555	53.1244	53.1244	52.8594	53.6756	54.5555	55.1774	55.8275	(38)
Heat transfer coeff	131.0777	130.7208	130.3710	128.7279	128.4205	126.9894	126.9894	126.7244	127.5407	128.4205	129.0424	129.6925	(39)
Average = Sum(39)m / 12 =												128.7264	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1655	1.1624	1.1593	1.1447	1.1419	1.1292	1.1292	1.1268	1.1341	1.1419	1.1475	1.1532	(40)
HLP (average)												1.1446	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
									Solar input (sum of months) = Sum(63)m =			-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
									Total per year (kWh/year) = Sum(64)m =			886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	10.6334	0.4600	0.0000	0.7700	8.1353	(74)
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	777.0833	875.2149	987.3917	1112.2541	1192.7922	1173.7726	1119.4759	1036.5642	937.6410	821.4062	750.3962	739.2614	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6352	32.7243	32.8121	33.2309	33.3105	33.6859	33.6859	33.7563	33.5403	33.3105	33.1499	32.9838	
alpha	3.1757	3.1816	3.1875	3.2154	3.2207	3.2457	3.2457	3.2504	3.2360	3.2207	3.2100	3.1989	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9756	0.9632	0.9355	0.8723	0.7636	0.6106	0.4715	0.5209	0.7392	0.9077	0.9636	0.9790	(86)
MIT	19.1483	19.3659	19.7468	20.2353	20.6306	20.8745	20.9595	20.9437	20.7559	20.2314	19.6074	19.1103	(87)
Th 2	19.9477	19.9502	19.9527	19.9645	19.9667	19.9771	19.9771	19.9790	19.9731	19.9667	19.9623	19.9576	(88)
util rest of house	0.9710	0.9563	0.9230	0.8472	0.7169	0.5351	0.3724	0.4203	0.6723	0.8840	0.9556	0.9750	(89)
MIT 2	17.4902	17.8057	18.3531	19.0455	19.5726	19.8723	19.9542	19.9447	19.7461	19.0570	18.1662	17.4414	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0021	18.2874	18.7834	19.4128	19.8993	20.1817	20.2646	20.2531	20.0578	19.4195	18.6112	17.9567	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8521	18.1374	18.6334	19.2628	19.7493	20.0317	20.1146	20.1031	19.9078	19.2695	18.4612	17.8067	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9579	0.9400	0.9028	0.8269	0.7059	0.5395	0.3863	0.4332	0.6675	0.8638	0.9395	0.9631	(94)
Useful gains	744.4008	822.7303	891.4437	919.7386	841.9707	633.1977	432.4655	449.0359	625.8747	709.5271	705.0147	711.9929	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1776.3820	1730.4066	1581.8388	1333.9869	1033.6914	689.7702	446.3113	469.2737	740.7367	1113.3477	1466.0723	1764.6825	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	767.7940	609.9584	513.6539	298.2588	142.6402	0.0000	0.0000	0.0000	0.0000	300.4425	547.9614	783.2011	(98)
Space heating												3963.9104	(98)
Space heating per m2											(98) / (4) =	35.2473	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4380.0115	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	767.7940	609.9584	513.6539	298.2588	142.6402	0.0000	0.0000	0.0000	0.0000	300.4425	547.9614	783.2011	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	848.3912	673.9872	567.5734	329.5677	157.6135	0.0000	0.0000	0.0000	0.0000	331.9807	605.4823	865.4156	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9488	89.9768	90.0029	90.0513	90.1067	87.3000	87.3000	87.3000	87.3000	89.7102	89.8644	89.9610	(217)
Fuel for water heating, kWh/month	171.3373	127.8064	101.2478	52.1066	21.3957	4.2204	0.0000	31.1465	57.4037	105.8592	145.7792	170.1105	(219)
Water heating fuel used												988.4132	(219)
Annual totals kWh/year													
Space heating fuel - main system												4380.0115	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4879.1275	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4380.0115	3.4800	152.4244	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4132	3.4800	34.3968	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			242.2829	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6463	(257)
SAP value		90.9848	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4380.0115	0.2160	946.0825	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4132	0.2160	213.4973	(264)
Space and water heating			1159.5797	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			905.6345	(272)
CO2 emissions per m2			8.0500	(273)
EI value			92.2930	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3709	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3431	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3603	0.3345	0.3431	0.3260	0.3260	0.3174	0.3088	0.3002	0.2916	0.3174	0.3002	0.3174	(22b)
Effective ac	0.5649	0.5560	0.5589	0.5531	0.5531	0.5504	0.5477	0.5451	0.5425	0.5504	0.5451	0.5504	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	15399.8890			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					136.9366			(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					13.1278			(36)
Total fabric heat loss				(33) + (36) =	73.8650			(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2551	53.3965	53.6756	53.1244	53.1244	52.8594	52.6014	52.3506	52.1067	52.8594	52.3506	52.8594	(38)
Heat transfer coeff	128.1201	127.2615	127.5407	126.9894	126.9894	126.7244	126.4665	126.2156	125.9718	126.7244	126.2156	126.7244	(39)
Average = Sum(39)m / 12 =												126.8287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1393	1.1316	1.1341	1.1292	1.1292	1.1268	1.1245	1.1223	1.1201	1.1268	1.1223	1.1268	(40)
HLP (average)												1.1278	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
										Solar input (sum of months) = Sum(63)m =		-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
										Total per year (kWh/year) = Sum(64)m =		856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	13.4839	0.4600	0.0000	0.7700	10.3161	(74)
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	138.8835	231.2467	385.0691	568.7832	667.1064	744.4712	702.0938	614.2558	474.0900	296.2626	172.5799	112.3074	(83)
Total gains	807.6458	894.6324	1022.0331	1164.8284	1220.9969	1261.0395	1197.2155	1119.0048	1002.7353	866.0586	787.9674	762.4326	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3886	33.6138	33.5403	33.6859	33.6859	33.7563	33.8251	33.8924	33.9580	33.7563	33.8924	33.7563	
alpha	3.2259	3.2409	3.2360	3.2457	3.2457	3.2504	3.2550	3.2595	3.2639	3.2504	3.2595	3.2504	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9699	0.9577	0.9224	0.8426	0.7154	0.5287	0.3981	0.4224	0.6696	0.8751	0.9512	0.9736	(86)
MIT	19.3319	19.5089	19.8995	20.3738	20.7308	20.9272	20.9783	20.9744	20.8398	20.3998	19.8158	19.3183	(87)
Th 2	19.9689	19.9751	19.9731	19.9771	19.9771	19.9790	19.9808	19.9827	19.9844	19.9790	19.9827	19.9790	(88)
util rest of house	0.9641	0.9498	0.9076	0.8125	0.6612	0.4479	0.2999	0.3195	0.5929	0.8432	0.9402	0.9685	(89)
MIT 2	17.7691	18.0272	18.5827	19.2417	19.7047	19.9250	19.9707	19.9704	19.8478	19.2951	18.4780	17.7564	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2516	18.4847	18.9892	19.5912	20.0215	20.2344	20.2818	20.2804	20.1540	19.6361	18.8910	18.2386	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1016	18.3347	18.8392	19.4412	19.8715	20.0844	20.1318	20.1304	20.0040	19.4861	18.7410	18.0886	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9328	0.8870	0.7942	0.6550	0.4566	0.3149	0.3349	0.5945	0.8246	0.9224	0.9552	(94)
Useful gains	766.9777	834.5343	906.5255	925.1613	799.7677	575.8192	376.9617	374.7947	596.1458	714.1135	726.8331	728.2399	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1691.3910	1658.8105	1509.9853	1262.4261	936.0965	606.2996	383.4158	382.4831	668.1581	1024.7125	1368.3053	1658.6465	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.7634	553.9136	448.9741	242.8307	101.4287	0.0000	0.0000	0.0000	0.0000	231.0857	461.8600	692.2225	(98)
Space heating												3420.0786	(98)
Space heating per m2											(98) / (4) =	30.4115	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3779.0924	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.7634	553.9136	448.9741	242.8307	101.4287	0.0000	0.0000	0.0000	0.0000	231.0857	461.8600	692.2225	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.9596	612.0592	496.1040	268.3212	112.0759	0.0000	0.0000	0.0000	0.0000	255.3433	510.3425	764.8868	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9107	89.9330	89.9464	89.9790	89.8788	87.3000	87.3000	87.3000	87.3000	89.5740	89.7948	89.9136	(217)
Fuel for water heating, kWh/month	166.5645	127.9565	100.7243	50.6313	26.2223	0.0000	0.0000	23.6468	51.5633	101.3326	140.2505	166.6270	(219)
Water heating fuel used												955.5191	(219)
Annual totals kWh/year													
Space heating fuel - main system												3779.0924	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4099.4890	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3779.0924	10.2300	386.6011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.5191	10.2300	97.7496	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			354.1338	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3779.0924	0.2160	816.2840	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.5191	0.2160	206.3921	(264)
Space and water heating			1022.6761	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			693.0475	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3779.0924	1.2200	4610.4927	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.5191	1.2200	1165.7333	(264)
Space and water heating			5776.2260	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3826.4001	(272)
Primary energy kWh/m2/year			34.0245	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	73.87	(37)
Summer heat loss coefficient	458.04	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
East	1.000	1.00	1.000	1.000	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.1600	81.1852	0.4600	0.0000	0.9000	72.5990
East	2.1700	117.5071	0.4600	0.0000	0.9000	105.5660
West	5.8100	117.5071	0.4600	0.0000	0.9000	282.6445
East	5.4600	117.5071	0.4600	0.0000	0.9000	265.6177
East	0.6500	176.6135	0.6300	0.7000	1.0000	45.5636
total:						771.9908

	Jun	Jul	Aug	
Solar gains	821	772	674	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1335	1264	1175	(P5)
Summer gain/loss ratio	2.91	2.76	2.57	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.96	21.70	21.41	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-306	**Issued on Date**	16/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	7, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.88	**TER**	17.18
Environmental	91 B	**% DER<TER**	36.67		
CO_2 Emissions (t/year)	0.86	**DFEE**	46.37	**TFEE**	53.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.04		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.18 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.88 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.56 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 7.63 m², No overhang
Windows facing South: 2.16 m², No overhang
Windows facing West: 5.81 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.5600	
Infiltration rate				0.3654	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4310	0.4225	0.4141	0.3718	0.3634	0.3211	0.3211	0.3127	0.3380	0.3634	0.3803	0.3972	(22b)
Effective ac	0.5929	0.5893	0.5857	0.5691	0.5660	0.5516	0.5516	0.5489	0.5571	0.5660	0.5723	0.5789	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.9421	56.5957	56.2562	54.6615	54.3631	52.9742	52.9742	52.7170	53.5092	54.3631	54.9667	55.5978	(38)
Heat transfer coeff	130.8072	130.4608	130.1213	128.5265	128.2282	126.8392	126.8392	126.5820	127.3742	128.2282	128.8318	129.4628	(39)
Average = Sum(39)m / 12 =												128.5251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1631	1.1601	1.1570	1.1429	1.1402	1.1279	1.1279	1.1256	1.1326	1.1402	1.1456	1.1512	(40)
HLP (average)												1.1429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	584.1797	700.6792	828.0568	961.0263	1045.3046	1030.3837	983.0985	906.6386	808.9465	676.7959	578.5493	547.7398	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7027	32.7895	32.8751	33.2830	33.3604	33.7257	33.7257	33.7943	33.5841	33.3604	33.2041	33.0423	
alpha	3.1802	3.1860	3.1917	3.2189	3.2240	3.2484	3.2484	3.2530	3.2389	3.2240	3.2136	3.2028	
util living area	0.9889	0.9796	0.9582	0.9066	0.8109	0.6669	0.5248	0.5781	0.7947	0.9414	0.9819	0.9909	(86)
MIT	18.9192	19.1673	19.5817	20.1092	20.5504	20.8370	20.9449	20.9238	20.6917	20.0922	19.4087	18.8791	(87)
Th 2	19.9496	19.9521	19.9545	19.9660	19.9681	19.9781	19.9781	19.9800	19.9743	19.9681	19.9638	19.9592	(88)
util rest of house	0.9867	0.9755	0.9495	0.8865	0.7686	0.5911	0.4188	0.4722	0.7335	0.9247	0.9776	0.9891	(89)
MIT 2	17.1601	17.5219	18.1220	18.8779	19.4780	19.8382	19.9460	19.9320	19.6779	18.8695	17.8829	17.1075	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.7032	18.0299	18.5727	19.2581	19.8091	20.1466	20.2544	20.2382	19.9909	19.2470	18.3540	17.6544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5532	17.8799	18.4227	19.1081	19.6591	19.9966	20.1044	20.0882	19.8409	19.0970	18.2040	17.5044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9789	0.9639	0.9323	0.8657	0.7540	0.5926	0.4327	0.4843	0.7242	0.9058	0.9668	0.9825	(94)
Useful gains	571.8665	675.3536	771.9693	831.9292	788.2050	610.6460	425.3561	439.0645	585.8155	613.0295	559.3408	538.1398	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1733.6162	1693.3617	1551.3920	1312.0086	1020.5772	684.4945	444.4935	466.8577	731.2466	1089.5572	1430.5434	1722.4302	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	864.3417	684.1015	579.8905	345.6572	172.8850	0.0000	0.0000	0.0000	0.0000	354.5366	627.2659	881.1121	(98)
Space heating												4509.7903	(98)
Space heating per m2											(98) / (4) =	40.1013	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4983.1937	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	864.3417	684.1015	579.8905	345.6572	172.8850	0.0000	0.0000	0.0000	0.0000	354.5366	627.2659	881.1121	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	955.0737	755.9133	640.7630	381.9416	191.0331	0.0000	0.0000	0.0000	0.0000	391.7531	693.1115	973.6045	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9330	89.8837	89.7767	89.5360	89.0459	87.3000	87.3000	87.3000	87.3000	89.5280	89.8270	89.9554	(217)
Fuel for water heating, kWh/month	199.6358	175.1366	181.9820	160.5542	155.9934	138.9421	130.3772	147.2980	148.3736	166.6504	179.4100	193.7710	(219)
Water heating fuel used												1978.1242	(219)
Annual totals kWh/year													
Space heating fuel - main system												4983.1937	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6422.0208	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4983.1937	0.2160	1076.3698	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.1242	0.2160	427.2748	(264)
Space and water heating			1503.6447	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1223.7494	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.8800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.8800	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		27.0346	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.0346	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
South	2.1600	46.7521	0.6300	0.7000	0.7700	30.8622	(78)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	118.2226	221.7375	347.0761	486.2832	583.7173	593.3858	566.5489	493.9066	396.4352	257.8501	145.5633	98.4751	(83)
Total gains	578.8153	679.9263	788.8833	901.4805	970.9987	954.1026	910.7177	845.4140	762.4940	650.7503	569.1197	545.3249	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9990	0.9976	0.9923	0.9707	0.9015	0.7478	0.5759	0.6367	0.8811	0.9857	0.9979	0.9993	(86)
MIT	19.7073	19.8595	20.1212	20.4695	20.7655	20.9404	20.9877	20.9798	20.8502	20.4535	20.0189	19.6867	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9987	0.9967	0.9895	0.9590	0.8621	0.6597	0.4545	0.5138	0.8188	0.9781	0.9970	0.9991	(89)
MIT 2	18.2430	18.4675	18.8507	19.3597	19.7608	19.9684	20.0048	20.0030	19.8784	19.3450	18.7105	18.2208	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9954	0.9866	0.9546	0.8654	0.6845	0.4922	0.5520	0.8315	0.9749	0.9959	0.9986	(94)
Useful gains	577.6921	676.7882	778.3083	860.5806	840.3506	653.0942	448.3007	466.6438	633.9933	634.3841	566.7580	544.5461	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1827.6867	1771.7276	1608.0959	1343.8408	1038.5680	694.4245	454.2877	477.2020	748.2952	1127.4226	1498.7544	1815.7561	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	929.9960	735.7992	617.3620	347.9473	147.4737	0.0000	0.0000	0.0000	0.0000	366.8206	671.0374	945.7802	(98)
Space heating												4762.2166	(98)
Space heating per m2											(98) / (4) =	42.3459	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5098.7329	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	929.9960	735.7992	617.3620	347.9473	147.4737	0.0000	0.0000	0.0000	0.0000	366.8206	671.0374	945.7802	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	995.7131	787.7936	660.9872	372.5346	157.8948	0.0000	0.0000	0.0000	0.0000	392.7416	718.4555	1012.6126	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3039	88.1190	87.6987	86.6942	84.6461	80.3000	80.3000	80.3000	80.3000	86.7287	87.8930	88.3716	(217)
Fuel for water heating, kWh/month	244.9993	216.3827	228.3061	206.6212	204.8859	190.2188	182.2441	203.1594	205.4031	214.5504	223.9165	238.9065	(219)
Water heating fuel used												2559.5941	(219)
Annual totals kWh/year													
Space heating fuel - main system												5098.7329	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8193.9292	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5098.7329	0.2160	1101.3263	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2559.5941	0.2160	552.8723	(264)
Space and water heating			1654.1986	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1932.1762	(272)
Emissions per m2 for space and water heating			14.7092	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7092 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.1800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.5600	
Infiltration rate				0.3654	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4310	0.4225	0.4141	0.3718	0.3634	0.3211	0.3211	0.3127	0.3380	0.3634	0.3803	0.3972	(22b)
Effective ac	0.5929	0.5893	0.5857	0.5691	0.5660	0.5516	0.5516	0.5489	0.5571	0.5660	0.5723	0.5789	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.9421	56.5957	56.2562	54.6615	54.3631	52.9742	52.9742	52.7170	53.5092	54.3631	54.9667	55.5978	(38)
Heat transfer coeff	130.8072	130.4608	130.1213	128.5265	128.2282	126.8392	126.8392	126.5820	127.3742	128.2282	128.8318	129.4628	(39)
Average = Sum(39)m / 12 =												128.5251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1631	1.1601	1.1570	1.1429	1.1402	1.1279	1.1279	1.1256	1.1326	1.1402	1.1456	1.1512	(40)
HLP (average)												1.1429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	549.7488	667.0978	796.2393	931.6076	1017.4468	1004.7214	959.2986	880.4486	781.9045	647.2712	546.2219	514.1548	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1553	32.2407	32.3248	32.7259	32.8020	33.1612	33.1612	33.2286	33.0220	32.8020	32.6484	32.4892	
alpha	3.1437	3.1494	3.1550	3.1817	3.1868	3.2107	3.2107	3.2152	3.2015	3.1868	3.1766	3.1659	
util living area	0.9902	0.9814	0.9609	0.9110	0.8177	0.6759	0.5342	0.5895	0.8045	0.9460	0.9839	0.9920	(86)
MIT	18.8519	19.1049	19.5284	20.0694	20.5247	20.8245	20.9396	20.9163	20.6699	20.0491	19.3502	18.8120	(87)
Th 2	19.9496	19.9521	19.9545	19.9660	19.9681	19.9781	19.9781	19.9800	19.9743	19.9681	19.9638	19.9592	(88)
util rest of house	0.9882	0.9777	0.9528	0.8918	0.7766	0.6008	0.4274	0.4833	0.7450	0.9305	0.9801	0.9904	(89)
MIT 2	17.9800	18.2329	18.6529	19.1868	19.6121	19.8742	19.9537	19.9434	19.7553	19.1785	18.4870	17.9472	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2492	18.5021	18.9232	19.4593	19.8938	20.1676	20.2581	20.2437	20.0377	19.4473	18.7535	18.2142	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2492	18.5021	18.9232	19.4593	19.8938	20.1676	20.2581	20.2437	20.0377	19.4473	18.7535	18.2142	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9709	0.9426	0.8805	0.7732	0.6158	0.4582	0.5126	0.7492	0.9206	0.9740	0.9867	(94)
Useful gains	540.8451	647.6521	750.5645	820.2813	786.7302	618.7290	439.5839	451.3240	585.7665	595.8776	532.0149	507.3169	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1824.6559	1774.5411	1616.5260	1357.1460	1050.6792	706.1888	463.9905	486.5468	756.3037	1134.4688	1501.3378	1814.3152	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

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	955.1553	757.2695	644.2754	386.5426	196.3781	0.0000	0.0000	0.0000	0.0000	400.7119	697.9125	972.4067 (98)
Space heating												5010.6519 (98)
Space heating per m2											(98) / (4) =	44.5550 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1192.2888	938.6104	962.0234	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7885	0.8522	0.8216	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	940.1209	799.8952	790.3507	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1278.8180	1223.7154	1134.9394	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	243.8620	315.3222	256.3741	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												815.5583	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.9655	78.8306	64.0935	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												203.8896	(107)
Space cooling per m2												1.8130	(108)
Energy for space heating												44.5550	(99)
Energy for space cooling												1.8130	(108)
Total												46.3680	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288 (42)
Average daily hot water use (litres/day)	101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.6300	19.6403	0.6300	0.7000	0.7700	45.7977	(76)
South	2.1600	46.7521	0.6300	0.7000	0.7700	30.8622	(78)
West	5.8100	19.6403	0.6300	0.7000	0.7700	34.8735	(80)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	118.2226	221.7375	347.0761	486.2832	583.7173	593.3858	566.5489	493.9066	396.4352	257.8501	145.5633	98.4751	(83)
Total gains	532.0170	633.9732	744.6854	859.7790	931.5408	917.5204	875.9895	807.6159	723.1574	608.8338	524.4144	499.3683	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9994	0.9982	0.9941	0.9757	0.9137	0.7675	0.5959	0.6610	0.8988	0.9892	0.9986	0.9995	(86)
MIT	19.6682	19.8214	20.0855	20.4390	20.7451	20.9326	20.9856	20.9760	20.8317	20.4205	19.9817	19.6482	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9991	0.9976	0.9918	0.9658	0.8775	0.6805	0.4717	0.5360	0.8417	0.9834	0.9980	0.9994	(89)
MIT 2	18.7542	18.9094	19.1746	19.5328	19.8195	19.9772	20.0057	20.0044	19.9054	19.5204	19.0804	18.7430	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0364	19.1910	19.4558	19.8126	20.1053	20.2721	20.3083	20.3044	20.1914	19.7983	19.3587	19.0225	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0364	19.1910	19.4558	19.8126	20.1053	20.2721	20.3083	20.3044	20.1914	19.7983	19.3587	19.0225	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9969	0.9903	0.9635	0.8820	0.7055	0.5105	0.5751	0.8543	0.9818	0.9974	0.9992	(94)
Useful gains	531.3931	632.0365	737.4260	828.4010	821.6047	647.3075	447.2064	464.4511	617.7973	597.7587	523.0555	498.9494	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1871.0204	1808.9045	1634.9596	1357.5537	1042.8203	694.8687	454.2847	477.1854	749.8923	1141.2055	1529.2150	1859.5553	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	996.6827	790.8553	667.7650	380.9900	164.5844	0.0000	0.0000	0.0000	0.0000	404.3244	724.4348	1012.2908	(98)
Space heating												5141.9274	(98)
Space heating per m2											(98) / (4) =	45.7223	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8490	0.9159	0.8869	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	977.6694	830.3262	823.8374	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1176.8948	1126.3410	1049.8104	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	143.4423	220.2351	168.1239	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												531.8013	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	35.8606	55.0588	42.0310	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												132.9503	(107)
Space cooling per m2												1.1822	(108)
Energy for space heating												45.7223	(99)
Energy for space cooling												1.1822	(108)
Total												46.9045	(109)
Target Fabric Energy Efficiency (TFEE)												53.9	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.5600	
Infiltration rate				0.3654	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3549	0.3296	0.3380	0.3211	0.3211	0.3127	0.3042	0.2958	0.2873	0.3127	0.2958	0.3127	(22b)
Effective ac	0.5630	0.5543	0.5571	0.5516	0.5516	0.5489	0.5463	0.5437	0.5413	0.5489	0.5437	0.5489	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	15399.8890			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.1278	(36)
Total fabric heat loss					(33) + (36) =		73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0716	53.2383	53.5092	52.9742	52.9742	52.7170	52.4666	52.2231	51.9865	52.7170	52.2231	52.7170	(38)
Heat transfer coeff	127.9367	127.1033	127.3742	126.8392	126.8392	126.5820	126.3317	126.0882	125.8515	126.5820	126.0882	126.5820	(39)
Average = Sum(39)m / 12 =												126.6832	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1376	1.1302	1.1326	1.1279	1.1279	1.1256	1.1233	1.1212	1.1191	1.1256	1.1212	1.1256	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)
Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4364	33.6557	33.5841	33.7257	33.7257	33.7943	33.8612	33.9266	33.9904	33.7943	33.9266	33.7943	
alpha	3.2291	3.2437	3.2389	3.2484	3.2484	3.2530	3.2574	3.2618	3.2660	3.2530	3.2618	3.2530	
util living area													
	0.9665	0.9523	0.9136	0.8317	0.7059	0.5210	0.3907	0.4106	0.6491	0.8602	0.9449	0.9708	(86)
MIT	19.3731	19.5591	19.9474	20.4033	20.7422	20.9304	20.9796	20.9765	20.8545	20.4388	19.8588	19.3542	(87)
Th 2	19.9702	19.9762	19.9743	19.9781	19.9781	19.9800	19.9818	19.9836	19.9853	19.9800	19.9836	19.9800	(88)
util rest of house													
	0.9601	0.9435	0.8976	0.8005	0.6513	0.4409	0.2941	0.3101	0.5723	0.8260	0.9328	0.9652	(89)
MIT 2	17.8290	18.0992	18.6497	19.2804	19.7183	19.9286	19.9722	19.9724	19.8625	19.3456	18.5389	17.8084	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3057	18.5499	19.0503	19.6271	20.0345	20.2379	20.2832	20.2824	20.1687	19.6831	18.9464	18.2857	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1557	18.3999	18.9003	19.4771	19.8845	20.0879	20.1332	20.1324	20.0187	19.5331	18.7964	18.1357	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9448	0.9256	0.8767	0.7829	0.6459	0.4498	0.3088	0.3253	0.5750	0.8081	0.9142	0.9512	(94)
Useful gains	794.3818	868.1970	937.8922	943.5909	806.0877	576.9687	377.1196	375.3213	604.0990	738.7874	755.6043	752.3053	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1695.8897	1665.0405	1515.7960	1265.4826	936.6383	606.0585	383.1933	382.3520	669.3696	1029.5064	1373.9069	1662.7383	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	670.7219	535.4789	429.9604	231.7620	97.1296	0.0000	0.0000	0.0000	0.0000	216.2950	445.1779	677.3622	(98)
Space heating												3303.8878	(98)
RHI space heating demand												3304	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.5600	
Infiltration rate				0.3654	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4310	0.4225	0.4141	0.3718	0.3634	0.3211	0.3211	0.3127	0.3380	0.3634	0.3803	0.3972	(22b)
Effective ac	0.5929	0.5893	0.5857	0.5691	0.5660	0.5516	0.5516	0.5489	0.5571	0.5660	0.5723	0.5789	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.9421	56.5957	56.2562	54.6615	54.3631	52.9742	52.9742	52.7170	53.5092	54.3631	54.9667	55.5978	(38)
Heat transfer coeff	130.8072	130.4608	130.1213	128.5265	128.2282	126.8392	126.8392	126.5820	127.3742	128.2282	128.8318	129.4628	(39)
Average = Sum(39)m / 12 =												128.5251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1631	1.1601	1.1570	1.1429	1.1402	1.1279	1.1279	1.1256	1.1326	1.1402	1.1456	1.1512	(40)
HLP (average)												1.1429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	804.7167	918.2478	1035.5940	1154.1570	1223.5139	1197.1550	1144.9798	1071.4883	983.8277	866.0835	782.7583	763.3869	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7027	32.7895	32.8751	33.2830	33.3604	33.7257	33.7257	33.7943	33.5841	33.3604	33.2041	33.0423	
alpha	3.1802	3.1860	3.1917	3.2189	3.2240	3.2484	3.2484	3.2530	3.2389	3.2240	3.2136	3.2028	
util living area	0.9732	0.9584	0.9277	0.8621	0.7534	0.6016	0.4620	0.5065	0.7193	0.8960	0.9594	0.9770	(86)
MIT	19.1853	19.4182	19.7986	20.2703	20.6471	20.8802	20.9620	20.9483	20.7764	20.2733	19.6467	19.1430	(87)
Th 2	19.9496	19.9521	19.9545	19.9660	19.9681	19.9781	19.9781	19.9800	19.9743	19.9681	19.9638	19.9592	(88)
util rest of house	0.9682	0.9507	0.9140	0.8357	0.7060	0.5264	0.3645	0.4077	0.6512	0.8702	0.9505	0.9727	(89)
MIT 2	17.5447	17.8815	18.4266	19.0928	19.5932	19.8786	19.9567	19.9487	19.7686	19.1137	18.2230	17.4896	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0512	18.3559	18.8502	19.4563	19.9186	20.1878	20.2671	20.2573	20.0797	19.4717	18.6626	18.0000	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9012	18.2059	18.7002	19.3063	19.7686	20.0378	20.1171	20.1073	19.9297	19.3217	18.5126	17.8500	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9544	0.9334	0.8933	0.8158	0.6958	0.5311	0.3783	0.4207	0.6479	0.8502	0.9337	0.9602	(94)
Useful gains	768.0350	857.1276	925.0630	941.6173	851.3360	635.7927	433.1231	450.7422	637.4612	736.3232	730.8401	733.0118	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1779.1304	1735.8997	1587.5082	1337.4895	1034.6173	689.7279	446.1028	469.2768	742.5557	1118.3677	1470.3008	1767.1720	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	752.2550	590.5349	492.8592	285.0280	136.3612	0.0000	0.0000	0.0000	0.0000	284.2411	532.4117	769.4152	(98)
Space heating												3843.1062	(98)
Space heating per m2											(98) / (4) =	34.1731	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4246.5262	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	752.2550	590.5349	492.8592	285.0280	136.3612	0.0000	0.0000	0.0000	0.0000	284.2411	532.4117	769.4152	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	831.2210	652.5247	544.5958	314.9481	150.6754	0.0000	0.0000	0.0000	0.0000	314.0786	588.3002	850.1825	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8653	89.8072	89.6816	89.4013	88.8564	87.3000	87.3000	87.3000	87.3000	89.3723	89.7357	89.8914	(217)
Fuel for water heating, kWh/month	199.7862	175.2858	182.1749	160.7960	156.3260	138.9421	130.3772	147.2980	148.3736	166.9407	179.5925	193.9090	(219)
Water heating fuel used												1979.8019	(219)
Annual totals kWh/year													
Space heating fuel - main system												4246.5262	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5687.0310	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4246.5262	3.4800	147.7791	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.8019	3.4800	68.8971	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			265.5429	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7083	(257)
SAP value		90.1193	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4246.5262	0.2160	917.2497	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8019	0.2160	427.6372	(264)
Space and water heating			1344.8869	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy for lighting	460.6022	0.5190	239.0525 (268)
Energy saving/generation technologies			
PV Unit	-1074.8994	0.5190	-557.8728 (269)
Total kg/year			1064.9916 (272)
CO2 emissions per m2			9.4700 (273)
EI value			90.9368
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.5600	
Infiltration rate		0.3654	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3549	0.3296	0.3380	0.3211	0.3211	0.3127	0.3042	0.2958	0.2873	0.3127	0.2958	0.3127	(22b)
Effective ac	0.5630	0.5543	0.5571	0.5516	0.5516	0.5489	0.5463	0.5437	0.5413	0.5489	0.5437	0.5489	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0716	53.2383	53.5092	52.9742	52.9742	52.7170	52.4666	52.2231	51.9865	52.7170	52.2231	52.7170	(38)
Heat transfer coeff	127.9367	127.1033	127.3742	126.8392	126.8392	126.5820	126.3317	126.0882	125.8515	126.5820	126.0882	126.5820	(39)
Average = Sum(39)m / 12 =												126.6832	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1376	1.1302	1.1326	1.1279	1.1279	1.1256	1.1233	1.1212	1.1191	1.1256	1.1212	1.1256	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4364	33.6557	33.5841	33.7257	33.7257	33.7943	33.8612	33.9266	33.9904	33.7943	33.9266	33.7943	
alpha	3.2291	3.2437	3.2389	3.2484	3.2484	3.2530	3.2574	3.2618	3.2660	3.2530	3.2618	3.2530	
util living area	0.9665	0.9523	0.9136	0.8317	0.7059	0.5210	0.3907	0.4106	0.6491	0.8602	0.9449	0.9708	(86)
MIT	19.3731	19.5591	19.9474	20.4033	20.7422	20.9304	20.9796	20.9765	20.8545	20.4388	19.8588	19.3542	(87)
Th 2	19.9702	19.9762	19.9743	19.9781	19.9781	19.9800	19.9818	19.9836	19.9853	19.9800	19.9836	19.9800	(88)
util rest of house	0.9601	0.9435	0.8976	0.8005	0.6513	0.4409	0.2941	0.3101	0.5723	0.8260	0.9328	0.9652	(89)
MIT 2	17.8290	18.0992	18.6497	19.2804	19.7183	19.9286	19.9722	19.9724	19.8625	19.3456	18.5389	17.8084	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3057	18.5499	19.0503	19.6271	20.0345	20.2379	20.2832	20.2824	20.1687	19.6831	18.9464	18.2857	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1557	18.3999	18.9003	19.4771	19.8845	20.0879	20.1332	20.1324	20.0187	19.5331	18.7964	18.1357	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9448	0.9256	0.8767	0.7829	0.6459	0.4498	0.3088	0.3253	0.5750	0.8081	0.9142	0.9512	(94)
Useful gains	794.3818	868.1970	937.8922	943.5909	806.0877	576.9687	377.1196	375.3213	604.0990	738.7874	755.6043	752.3053	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1695.8897	1665.0405	1515.7960	1265.4826	936.6383	606.0585	383.1933	382.3520	669.3696	1029.5064	1373.9069	1662.7383	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.7219	535.4789	429.9604	231.7620	97.1296	0.0000	0.0000	0.0000	0.0000	216.2950	445.1779	677.3622	(98)
Space heating												3303.8878	(98)
Space heating per m2											(98) / (4) =	29.3783	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3650.7048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.7219	535.4789	429.9604	231.7620	97.1296	0.0000	0.0000	0.0000	0.0000	216.2950	445.1779	677.3622	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.1292	591.6894	475.0944	256.0906	107.3255	0.0000	0.0000	0.0000	0.0000	239.0000	491.9092	748.4665	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8049	89.7526	89.5957	89.2477	88.5890	87.3000	87.3000	87.3000	87.3000	89.1658	89.6268	89.8261	(217)
Fuel for water heating, kWh/month	199.9206	175.3924	182.3495	161.0729	156.7978	138.9421	130.3772	147.2980	148.3736	167.3274	179.8107	194.0499	(219)
Water heating fuel used												1981.7122	(219)
Annual totals kWh/year													
Space heating fuel - main system												3650.7048	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4947.2945	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3650.7048	10.2300	373.4671	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.7122	10.2300	202.7292	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			427.6193	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3650.7048	0.2160	788.5522	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.7122	0.2160	428.0498	(264)
Space and water heating			1216.6021	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			861.0235	(272)

13a. Primary energy - Individual heating systems including micro-CHP

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3650.7048	1.2200	4453.8598	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.7122	1.2200	2417.6889	(264)
Space and water heating			6871.5487	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			4768.2228	(272)
Primary energy kWh/m2/year			42.3993	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (22.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	B 91	A 93
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£679	£574	£105
Space heating	£504	£504	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£448	-£448	£0
Total cost of fuels	£428	£341	£87
Total cost of uses	£428	£341	£87
Delivered energy	44 kWh/m²	35 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	33 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.5600	
Infiltration rate		0.3654	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4310	0.4225	0.4141	0.3718	0.3634	0.3211	0.3211	0.3127	0.3380	0.3634	0.3803	0.3972	(22b)
Effective ac	0.5929	0.5893	0.5857	0.5691	0.5660	0.5516	0.5516	0.5489	0.5571	0.5660	0.5723	0.5789	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.9421	56.5957	56.2562	54.6615	54.3631	52.9742	52.9742	52.7170	53.5092	54.3631	54.9667	55.5978	(38)
Heat transfer coeff	130.8072	130.4608	130.1213	128.5265	128.2282	126.8392	126.8392	126.5820	127.3742	128.2282	128.8318	129.4628	(39)
Average = Sum(39)m / 12 =												128.5251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1631	1.1601	1.1570	1.1429	1.1402	1.1279	1.1279	1.1256	1.1326	1.1402	1.1456	1.1512	(40)
HLP (average)												1.1429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
									Solar input (sum of months) = Sum(63)m =			-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
									Total per year (kWh/year) = Sum(64)m =			886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	19.6403	0.4600	0.0000	0.7700	15.0958	(76)
South	2.1600	46.7521	0.4600	0.0000	0.7700	35.7687	(78)
West	5.8100	19.6403	0.4600	0.0000	0.7700	40.4177	(80)
East	5.4600	19.6403	0.4600	0.0000	0.7700	37.9829	(76)
East	0.6500	25.9287	0.6300	0.7000	1.0000	6.6892	(82)

Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	804.7167	918.2478	1035.5940	1154.1570	1223.5139	1197.1550	1144.9798	1071.4883	983.8277	866.0835	782.7583	763.3869	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7027	32.7895	32.8751	33.2830	33.3604	33.7257	33.7257	33.7943	33.5841	33.3604	33.2041	33.0423	
alpha	3.1802	3.1860	3.1917	3.2189	3.2240	3.2484	3.2484	3.2530	3.2389	3.2240	3.2136	3.2028	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9732	0.9584	0.9277	0.8621	0.7534	0.6016	0.4620	0.5065	0.7193	0.8960	0.9594	0.9770	(86)
MIT	19.1853	19.4182	19.7986	20.2703	20.6471	20.8802	20.9620	20.9483	20.7764	20.2733	19.6467	19.1430	(87)
Th 2	19.9496	19.9521	19.9545	19.9660	19.9681	19.9781	19.9781	19.9800	19.9743	19.9681	19.9638	19.9592	(88)
util rest of house	0.9682	0.9507	0.9140	0.8357	0.7060	0.5264	0.3645	0.4077	0.6512	0.8702	0.9505	0.9727	(89)
MIT 2	17.5447	17.8815	18.4266	19.0928	19.5932	19.8786	19.9567	19.9487	19.7686	19.1137	18.2230	17.4896	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0512	18.3559	18.8502	19.4563	19.9186	20.1878	20.2671	20.2573	20.0797	19.4717	18.6626	18.0000	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9012	18.2059	18.7002	19.3063	19.7686	20.0378	20.1171	20.1073	19.9297	19.3217	18.5126	17.8500	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9544	0.9334	0.8933	0.8158	0.6958	0.5311	0.3783	0.4207	0.6479	0.8502	0.9337	0.9602	(94)
Useful gains	768.0350	857.1276	925.0630	941.6173	851.3360	635.7927	433.1231	450.7422	637.4612	736.3232	730.8401	733.0118	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1779.1304	1735.8997	1587.5082	1337.4895	1034.6173	689.7279	446.1028	469.2768	742.5557	1118.3677	1470.3008	1767.1720	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	752.2550	590.5349	492.8592	285.0280	136.3612	0.0000	0.0000	0.0000	0.0000	284.2411	532.4117	769.4152	(98)
Space heating												3843.1062	(98)
Space heating per m2											(98) / (4) =	34.1731	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4246.5262	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	752.2550	590.5349	492.8592	285.0280	136.3612	0.0000	0.0000	0.0000	0.0000	284.2411	532.4117	769.4152	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	831.2210	652.5247	544.5958	314.9481	150.6754	0.0000	0.0000	0.0000	0.0000	314.0786	588.3002	850.1825	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9394	89.9625	89.9853	90.0335	90.0909	87.3000	87.3000	87.3000	87.3000	89.6768	89.8496	89.9530	(217)
Fuel for water heating, kWh/month	171.3551	127.8267	101.2676	52.1169	21.3995	4.2204	0.0000	31.1465	57.4037	105.8986	145.8032	170.1256	(219)
Water heating fuel used												988.5639	(219)
Annual totals kWh/year													
Space heating fuel - main system												4246.5262	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4745.7930	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4246.5262	3.4800	147.7791	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.5639	3.4800	34.4020	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			237.6428	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6339	(257)
SAP value		91.1574	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4246.5262	0.2160	917.2497	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.5639	0.2160	213.5298	(264)
Space and water heating			1130.7795	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			876.8342	(272)
CO2 emissions per m2			7.8000	(273)
EI value			92.5381	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.5600	
Infiltration rate			0.3654	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3380	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3549	0.3296	0.3380	0.3211	0.3211	0.3127	0.3042	0.2958	0.2873	0.3127	0.2958	0.3127	(22b)
Effective ac	0.5630	0.5543	0.5571	0.5516	0.5516	0.5489	0.5463	0.5437	0.5413	0.5489	0.5437	0.5489	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0716	53.2383	53.5092	52.9742	52.9742	52.7170	52.4666	52.2231	51.9865	52.7170	52.2231	52.7170	(38)
Heat transfer coeff	127.9367	127.1033	127.3742	126.8392	126.8392	126.5820	126.3317	126.0882	125.8515	126.5820	126.0882	126.5820	(39)
Average = Sum(39)m / 12 =												126.6832	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1376	1.1302	1.1326	1.1279	1.1279	1.1256	1.1233	1.1212	1.1191	1.1256	1.1212	1.1256	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
										Solar input (sum of months) = Sum(63)m =		-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
										Total per year (kWh/year) = Sum(64)m =		856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	25.1925	0.4600	0.0000	0.7700	19.3633	(76)
South	2.1600	56.7559	0.4600	0.0000	0.7700	43.4223	(78)
West	5.8100	25.1925	0.4600	0.0000	0.7700	51.8438	(80)
East	5.4600	25.1925	0.4600	0.0000	0.7700	48.7207	(76)
East	0.6500	33.4886	0.6300	0.7000	1.0000	8.6396	(82)

Solar gains	171.9897	274.5844	432.8817	609.1837	694.1650	766.2450	725.9631	649.0663	521.8770	344.4305	211.0986	140.8066	(83)
Total gains	840.7520	937.9701	1069.8457	1205.2289	1248.0555	1282.8132	1221.0848	1153.8153	1050.5222	914.2266	826.4861	790.9318	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4364	33.6557	33.5841	33.7257	33.7257	33.7943	33.8612	33.9266	33.9904	33.7943	33.9266	33.7943	
alpha	3.2291	3.2437	3.2389	3.2484	3.2484	3.2530	3.2574	3.2618	3.2660	3.2530	3.2618	3.2530	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9665	0.9523	0.9136	0.8317	0.7059	0.5210	0.3907	0.4106	0.6491	0.8602	0.9449	0.9708	(86)
MIT	19.3731	19.5591	19.9474	20.4033	20.7422	20.9304	20.9796	20.9765	20.8545	20.4388	19.8588	19.3542	(87)
Th 2	19.9702	19.9762	19.9743	19.9781	19.9781	19.9800	19.9818	19.9836	19.9853	19.9800	19.9836	19.9800	(88)
util rest of house													
	0.9601	0.9435	0.8976	0.8005	0.6513	0.4409	0.2941	0.3101	0.5723	0.8260	0.9328	0.9652	(89)
MIT 2	17.8290	18.0992	18.6497	19.2804	19.7183	19.9286	19.9722	19.9724	19.8625	19.3456	18.5389	17.8084	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3057	18.5499	19.0503	19.6271	20.0345	20.2379	20.2832	20.2824	20.1687	19.6831	18.9464	18.2857	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1557	18.3999	18.9003	19.4771	19.8845	20.0879	20.1332	20.1324	20.0187	19.5331	18.7964	18.1357	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9448	0.9256	0.8767	0.7829	0.6459	0.4498	0.3088	0.3253	0.5750	0.8081	0.9142	0.9512	(94)
Useful gains	794.3818	868.1970	937.8922	943.5909	806.0877	576.9687	377.1196	375.3213	604.0990	738.7874	755.6043	752.3053	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1695.8897	1665.0405	1515.7960	1265.4826	936.6383	606.0585	383.1933	382.3520	669.3696	1029.5064	1373.9069	1662.7383	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	670.7219	535.4789	429.9604	231.7620	97.1296	0.0000	0.0000	0.0000	0.0000	216.2950	445.1779	677.3622	(98)
Space heating												3303.8878	(98)
Space heating per m2											(98) / (4) =	29.3783	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3650.7048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	670.7219	535.4789	429.9604	231.7620	97.1296	0.0000	0.0000	0.0000	0.0000	216.2950	445.1779	677.3622	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	741.1292	591.6894	475.0944	256.0906	107.3255	0.0000	0.0000	0.0000	0.0000	239.0000	491.9092	748.4665	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8985	89.9170	89.9263	89.9583	89.8568	87.3000	87.3000	87.3000	87.3000	89.5299	89.7744	89.9031	(217)
Fuel for water heating, kWh/month													
	166.5870	127.9793	100.7469	50.6430	26.2287	0.0000	0.0000	23.6468	51.5633	101.3825	140.2824	166.6464	(219)
Water heating fuel used												955.7062	(219)
Annual totals kWh/year													
Space heating fuel - main system												3650.7048	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3971.2885	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3650.7048	10.2300	373.4671	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.7062	10.2300	97.7687	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			341.0189	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3650.7048	0.2160	788.5522	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.7062	0.2160	206.4325	(264)
Space and water heating			994.9848	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			665.3562	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3650.7048	1.2200	4453.8598	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.7062	1.2200	1165.9615	(264)
Space and water heating			5619.8213	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3669.9954	(272)
Primary energy kWh/m2/year			32.6338	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	73.87	(37)
Summer heat loss coefficient	458.04	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
East	1.000	1.00	1.000	1.000	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	2.1700	117.5071	0.4600	0.0000	0.9000	105.5660
South	2.1600	112.2060	0.4600	0.0000	0.9000	100.3391
West	5.8100	117.5071	0.4600	0.0000	0.9000	282.6445
East	5.4600	117.5071	0.4600	0.0000	0.9000	265.6177
East	0.6500	176.6135	0.6300	0.7000	1.0000	45.5636
total:						799.7309

	Jun	Jul	Aug	
Solar gains	847	800	714	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1360	1292	1215	(P5)
Summer gain/loss ratio	2.97	2.82	2.65	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	20.01	21.76	21.49	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-307	**Issued on Date**	10/02/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-As-SEMI
Property	9, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	89 B	**DER**	11.70	**TER**	17.77
Environmental	90 B	**% DER<TER**	34.17		
CO_2 Emissions (t/year)	0.92	**DFEE**	47.19	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.31		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.70 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.2 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.67 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3402	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4012	0.3934	0.3855	0.3462	0.3383	0.2990	0.2990	0.2911	0.3147	0.3383	0.3540	0.3698	(22b)
Effective ac	0.5805	0.5774	0.5743	0.5599	0.5572	0.5447	0.5447	0.5424	0.5495	0.5572	0.5627	0.5684	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8603	53.5703	53.2860	51.9509	51.7011	50.5382	50.5382	50.3229	50.9861	51.7011	52.2064	52.7347	(38)
Heat transfer coeff	123.6515	123.3615	123.0773	121.7421	121.4923	120.3294	120.3294	120.1141	120.7774	121.4923	121.9977	122.5260	(39)
Average = Sum(39)m / 12 =												121.7409	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1405	1.1378	1.1352	1.1229	1.1206	1.1098	1.1098	1.1079	1.1140	1.1206	1.1252	1.1301	(40)
HLP (average)												1.1229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2841	33.3623	33.4394	33.8061	33.8756	34.2030	34.2030	34.2643	34.0761	33.8756	33.7353	33.5898	
alpha	3.2189	3.2242	3.2293	3.2537	3.2584	3.2802	3.2802	3.2843	3.2717	3.2584	3.2490	3.2393	
util living area	0.9908	0.9849	0.9703	0.9326	0.8545	0.7237	0.5839	0.6398	0.8431	0.9573	0.9857	0.9923	(86)
MIT	18.9109	19.1157	19.4954	20.0089	20.4715	20.7956	20.9270	20.8999	20.6300	20.0240	19.3792	18.8765	(87)
Th 2	19.9679	19.9701	19.9722	19.9822	19.9841	19.9928	19.9928	19.9944	19.9894	19.9841	19.9803	19.9763	(88)
util rest of house	0.9890	0.9818	0.9640	0.9170	0.8183	0.6509	0.4735	0.5322	0.7901	0.9446	0.9823	0.9908	(89)
MIT 2	17.1593	17.4586	18.0110	18.7528	19.3935	19.8111	19.9483	19.9282	19.6207	18.7862	17.8506	17.1141	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.3997	17.6861	18.2147	18.9252	19.5415	19.9462	20.0826	20.0616	19.7592	18.9561	18.0604	17.3559	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2497	17.5361	18.0647	18.7752	19.3915	19.7962	19.9326	19.9116	19.6092	18.8061	17.9104	17.2059	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8924	0.7926	0.6347	0.4663	0.5223	0.7651	0.9233	0.9714	0.9840	(94)
Useful gains	516.7303	586.6540	658.5398	712.6062	687.9514	544.1620	380.1309	391.2368	510.1383	527.2578	496.3519	490.3435	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1601.2464	1558.8044	1423.3513	1202.2219	934.4560	625.2573	401.0134	421.7930	665.3914	996.9807	1318.8405	1593.5662	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	806.8800	653.2851	569.0198	352.5233	183.3995	0.0000	0.0000	0.0000	0.0000	349.4738	592.1918	820.7977	(98)
Space heating												4327.5709	(98)
Space heating per m2											(98) / (4) =	39.9149	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4781.8463	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	806.8800	653.2851	569.0198	352.5233	183.3995	0.0000	0.0000	0.0000	0.0000	349.4738	592.1918	820.7977	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	891.5801	721.8620	628.7511	389.5285	202.6513	0.0000	0.0000	0.0000	0.0000	386.1589	654.3556	906.9588	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9012	89.8614	89.7670	89.5502	89.0935	87.3000	87.3000	87.3000	87.3000	89.5192	89.7969	89.9236	(217)
Fuel for water heating, kWh/month													
	199.2996	174.8387	181.6839	160.2975	155.7206	138.8278	130.3257	147.1641	148.2179	166.4271	179.1459	193.4620	(219)
Water heating fuel used												1975.4108	(219)
Annual totals kWh/year													
Space heating fuel - main system												4781.8463	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												6389.8573	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4781.8463	0.2160	1032.8788	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.4108	0.2160	426.6887	(264)
Space and water heating			1459.5675	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total CO2, kg/year			1268.8870	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.7000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.7000	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		28.1355	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.1355	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3758	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3476	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4432	0.4345	0.4258	0.3823	0.3737	0.3302	0.3302	0.3215	0.3476	0.3737	0.3910	0.4084	(22b)
Effective ac	0.5982	0.5944	0.5906	0.5731	0.5698	0.5545	0.5545	0.5517	0.5604	0.5698	0.5765	0.5834	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.5034	55.1496	54.8028	53.1739	52.8692	51.4504	51.4504	51.1877	51.9969	52.8692	53.4857	54.1302	(38)
Heat transfer coeff	125.2947	124.9409	124.5941	122.9652	122.6604	121.2417	121.2417	120.9790	121.7882	122.6604	123.2769	123.9215	(39)
Average = Sum(39)m / 12 =												122.9637	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1556	1.1524	1.1492	1.1342	1.1313	1.1183	1.1183	1.1158	1.1233	1.1313	1.1370	1.1430	(40)
HLP (average)												1.1341	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3532	32.4448	32.5351	32.9661	33.0480	33.4347	33.4347	33.5073	33.2847	33.0480	32.8827	32.7117	
alpha	3.1569	3.1630	3.1690	3.1977	3.2032	3.2290	3.2290	3.2338	3.2190	3.2032	3.1922	3.1808	
util living area	0.9920	0.9866	0.9731	0.9375	0.8633	0.7364	0.5983	0.6563	0.8549	0.9620	0.9877	0.9934	(86)
MIT	18.8156	19.0258	19.4164	19.9492	20.4302	20.7749	20.9174	20.8869	20.5966	19.9649	19.3012	18.7856	(87)
Th 2	19.9557	19.9583	19.9609	19.9730	19.9753	19.9859	19.9859	19.9879	19.9819	19.9753	19.9707	19.9659	(88)
util rest of house	0.9904	0.9839	0.9673	0.9230	0.8286	0.6646	0.4868	0.5484	0.8042	0.9505	0.9847	0.9921	(89)
MIT 2	17.9484	18.1594	18.5486	19.0799	19.5379	19.8478	19.9511	19.9360	19.7043	19.1041	18.4437	17.9258	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0674	18.2783	18.6677	19.1992	19.6604	19.9751	20.0837	20.0665	19.8268	19.2222	18.5614	18.0438	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0674	18.2783	18.6677	19.1992	19.6604	19.9751	20.0837	20.0665	19.8268	19.2222	18.5614	18.0438	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9777	0.9576	0.9091	0.8159	0.6637	0.4985	0.5577	0.7949	0.9392	0.9789	0.9885	(94)
Useful gains	485.4624	558.0921	635.5566	699.1265	685.4361	551.9454	394.4777	403.1212	508.4198	508.5244	468.5156	459.3636	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1724.9785	1671.4943	1516.0254	1266.4457	976.4209	651.6835	422.3739	443.5715	697.4516	1057.6085	1412.9252	1715.5439	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	922.2000	748.2063	655.0688	408.4698	216.4927	0.0000	0.0000	0.0000	0.0000	408.5186	679.9749	934.5981	(98)
Space heating												4973.5293	(98)
Space heating per m2											(98) / (4) =	45.8728	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1139.6718	897.1885	919.4401	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7436	0.8143	0.7783	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	847.4132	730.6143	715.5575	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	169.3263	225.1266	178.4620	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												572.9150	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.3316	56.2817	44.6155	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												143.2287	(107)
Space cooling per m2												1.3211	(108)
Energy for space heating												45.8728	(99)
Energy for space cooling												1.3211	(108)
Total												47.1939	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.6700	
Infiltration rate			0.3402	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3304	0.3068	0.3147	0.2990	0.2990	0.2911	0.2832	0.2753	0.2675	0.2911	0.2753	0.2911	(22b)
Effective ac	0.5546	0.5471	0.5495	0.5447	0.5447	0.5424	0.5401	0.5379	0.5358	0.5424	0.5379	0.5424	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4570	50.7593	50.9861	50.5382	50.5382	50.3229	50.1133	49.9094	49.7113	50.3229	49.9094	50.3229	(38)
Heat transfer coeff	121.2483	120.5505	120.7774	120.3294	120.3294	120.1141	119.9045	119.7006	119.5025	120.1141	119.7006	120.1141	(39)
Average = Sum(39)m / 12 =												120.1988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1183	1.1119	1.1140	1.1098	1.1098	1.1079	1.1059	1.1040	1.1022	1.1079	1.1040	1.1079	(40)
HLP (average)												1.1086	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9438	34.1403	34.0761	34.2030	34.2030	34.2643	34.3242	34.3827	34.4397	34.2643	34.3827	34.2643	
alpha	3.2629	3.2760	3.2717	3.2802	3.2802	3.2843	3.2883	3.2922	3.2960	3.2843	3.2922	3.2843	
util living area	0.9705	0.9606	0.9315	0.8647	0.7502	0.5693	0.4327	0.4552	0.6994	0.8857	0.9532	0.9738	(86)
MIT	19.3566	19.5108	19.8718	20.3266	20.6955	20.9126	20.9735	20.9693	20.8217	20.3840	19.8227	19.3448	(87)
Th 2	19.9859	19.9911	19.9894	19.9928	19.9928	19.9944	19.9960	19.9975	19.9990	19.9944	19.9975	19.9944	(88)
util rest of house	0.9649	0.9532	0.9181	0.8376	0.6986	0.4867	0.3290	0.3476	0.6244	0.8560	0.9428	0.9688	(89)
MIT 2	17.8156	18.0407	18.5562	19.1931	19.6791	19.9280	19.9832	19.9825	19.8439	19.2867	18.4981	17.8045	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0271	18.2425	18.7368	19.3487	19.8186	20.0631	20.1191	20.1179	19.9781	19.4373	18.6799	18.0159	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8771	18.0925	18.5868	19.1987	19.6686	19.9131	19.9691	19.9679	19.8281	19.2873	18.5299	17.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6798	0.4796	0.3261	0.3443	0.6100	0.8297	0.9216	0.9532	(94)
Useful gains	728.6644	779.2432	829.0239	836.1908	724.7045	522.8711	337.8370	336.0819	543.0070	657.8395	683.9918	695.5301	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1573.4524	1542.1424	1399.4208	1167.0366	862.5918	554.1002	344.0162	343.2945	612.8167	947.3801	1272.4026	1545.3773 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	628.5223	512.6682	424.3753	238.2090	102.5882	0.0000	0.0000	0.0000	0.0000	215.4181	423.6558	632.2863 (98)
Space heating												3177.7232 (98)
RHI space heating demand												3178 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.6700	
Infiltration rate			0.3402	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4012	0.3934	0.3855	0.3462	0.3383	0.2990	0.2990	0.2911	0.3147	0.3383	0.3540	0.3698	(22b)
Effective ac	0.5805	0.5774	0.5743	0.5599	0.5572	0.5447	0.5447	0.5424	0.5495	0.5572	0.5627	0.5684	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8603	53.5703	53.2860	51.9509	51.7011	50.5382	50.5382	50.3229	50.9861	51.7011	52.2064	52.7347	(38)
Heat transfer coeff	123.6515	123.3615	123.0773	121.7421	121.4923	120.3294	120.3294	120.1141	120.7774	121.4923	121.9977	122.5260	(39)
Average = Sum(39)m / 12 =												121.7409	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1405	1.1378	1.1352	1.1229	1.1206	1.1098	1.1098	1.1079	1.1140	1.1206	1.1252	1.1301	(40)
HLP (average)												1.1229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2841	33.3623	33.4394	33.8061	33.8756	34.2030	34.2030	34.2643	34.0761	33.8756	33.7353	33.5898	
alpha	3.2189	3.2242	3.2293	3.2537	3.2584	3.2802	3.2802	3.2843	3.2717	3.2584	3.2490	3.2393	
util living area	0.9757	0.9653	0.9424	0.8899	0.7945	0.6491	0.5069	0.5538	0.7630	0.9145	0.9644	0.9788	(86)
MIT	19.1882	19.3809	19.7310	20.1932	20.5908	20.8540	20.9519	20.9350	20.7371	20.2239	19.6293	19.1509	(87)
Th 2	19.9679	19.9701	19.9722	19.9822	19.9841	19.9928	19.9928	19.9944	19.9894	19.9841	19.9803	19.9763	(88)
util rest of house	0.9711	0.9589	0.9312	0.8674	0.7511	0.5741	0.4044	0.4512	0.6989	0.8924	0.9566	0.9748	(89)
MIT 2	17.5606	17.8402	18.3446	19.0033	19.5403	19.8681	19.9648	19.9537	19.7407	19.0599	18.2093	17.5118	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7840	18.0517	18.5349	19.1666	19.6845	20.0034	20.1003	20.0884	19.8775	19.2197	18.4042	17.7368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6340	17.9017	18.3849	19.0166	19.5345	19.8534	19.9503	19.9384	19.7275	19.0697	18.2542	17.5868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9079	0.8410	0.7288	0.5627	0.3998	0.4450	0.6796	0.8663	0.9377	0.9610	(94)
Useful gains	711.9918	770.5947	817.5821	831.7621	760.6477	574.9232	389.7808	405.7861	570.5954	656.8528	668.6111	683.9160	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1648.7636	1603.9035	1462.7578	1231.6130	951.8308	632.1418	403.1380	425.0112	679.6723	1028.9983	1360.7820	1640.2265	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	696.9582	559.9835	480.0108	287.8926	142.2402	0.0000	0.0000	0.0000	0.0000	276.8762	498.3630	711.4950	(98)
Space heating												3653.8195	(98)
Space heating per m2											(98) / (4) =	33.7006	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4037.3696	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.9582	559.9835	480.0108	287.8926	142.2402	0.0000	0.0000	0.0000	0.0000	276.8762	498.3630	711.4950	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	770.1196	618.7663	530.3986	318.1134	157.1715	0.0000	0.0000	0.0000	0.0000	305.9405	550.6774	786.1823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8266	89.7790	89.6665	89.4096	88.8912	87.3000	87.3000	87.3000	87.3000	89.3542	89.6977	89.8529	(217)
Fuel for water heating, kWh/month													
	199.4651	174.9993	181.8875	160.5496	156.0751	138.8278	130.3257	147.1641	148.2179	166.7346	179.3440	193.6141	(219)
Water heating fuel used												1977.2047	(219)
Annual totals kWh/year													
Space heating fuel - main system												4037.3696	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												5647.1745	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4037.3696	3.4800	140.5005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.2047	3.4800	68.8067	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			280.8471	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7688	(257)
SAP value		89.2746	
SAP rating (Section 12)		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4037.3696	0.2160	872.0718	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.2047	0.2160	427.0762	(264)
Space and water heating			1299.1481	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			1108.4675	(272)

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CO2 emissions per m2	10.2200 (273)
EI value	90.3184
EI rating	90 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3402	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3304	0.3068	0.3147	0.2990	0.2990	0.2911	0.2832	0.2753	0.2675	0.2911	0.2753	0.2911	(22b)
Effective ac	0.5546	0.5471	0.5495	0.5447	0.5447	0.5424	0.5401	0.5379	0.5358	0.5424	0.5379	0.5424	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4570	50.7593	50.9861	50.5382	50.5382	50.3229	50.1133	49.9094	49.7113	50.3229	49.9094	50.3229	(38)
Heat transfer coeff	121.2483	120.5505	120.7774	120.3294	120.3294	120.1141	119.9045	119.7006	119.5025	120.1141	119.7006	120.1141	(39)
Average = Sum(39)m / 12 =												120.1988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1183	1.1119	1.1140	1.1098	1.1098	1.1079	1.1059	1.1040	1.1022	1.1079	1.1040	1.1079	(40)
HLP (average)												1.1086	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9438	34.1403	34.0761	34.2030	34.2030	34.2643	34.3242	34.3827	34.4397	34.2643	34.3827	34.2643	
alpha	3.2629	3.2760	3.2717	3.2802	3.2802	3.2843	3.2883	3.2922	3.2960	3.2843	3.2922	3.2843	
util living area	0.9705	0.9606	0.9315	0.8647	0.7502	0.5693	0.4327	0.4552	0.6994	0.8857	0.9532	0.9738	(86)
MIT	19.3566	19.5108	19.8718	20.3266	20.6955	20.9126	20.9735	20.9693	20.8217	20.3840	19.8227	19.3448	(87)
Th 2	19.9859	19.9911	19.9894	19.9928	19.9928	19.9944	19.9960	19.9975	19.9990	19.9944	19.9975	19.9944	(88)
util rest of house	0.9649	0.9532	0.9181	0.8376	0.6986	0.4867	0.3290	0.3476	0.6244	0.8560	0.9428	0.9688	(89)
MIT 2	17.8156	18.0407	18.5562	19.1931	19.6791	19.9280	19.9832	19.9825	19.8439	19.2867	18.4981	17.8045	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0271	18.2425	18.7368	19.3487	19.8186	20.0631	20.1191	20.1179	19.9781	19.4373	18.6799	18.0159	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8771	18.0925	18.5868	19.1987	19.6686	19.9131	19.9691	19.9679	19.8281	19.2873	18.5299	17.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6798	0.4796	0.3261	0.3443	0.6100	0.8297	0.9216	0.9532	(94)
Useful gains	728.6644	779.2432	829.0239	836.1908	724.7045	522.8711	337.8370	336.0819	543.0070	657.8395	683.9918	695.5301	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1573.4524	1542.1424	1399.4208	1167.0366	862.5918	554.1002	344.0162	343.2945	612.8167	947.3801	1272.4026	1545.3773	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	628.5223	512.6682	424.3753	238.2090	102.5882	0.0000	0.0000	0.0000	0.0000	215.4181	423.6558	632.2863	(98)
Space heating												3177.7232	(98)
Space heating per m2											(98) / (4) =	29.3094	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3511.2964	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	628.5223	512.6682	424.3753	238.2090	102.5882	0.0000	0.0000	0.0000	0.0000	215.4181	423.6558	632.2863	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	694.4998	566.4842	468.9230	263.2144	113.3571	0.0000	0.0000	0.0000	0.0000	238.0311	468.1280	698.6589	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7701	89.7285	89.5883	89.2696	88.6323	87.3000	87.3000	87.3000	87.3000	89.1638	89.5962	89.7898	(217)
Fuel for water heating, kWh/month	199.5908	175.0977	182.0462	160.8013	156.5310	138.8278	130.3257	147.1641	148.2179	167.0906	179.5472	193.7501	(219)
Water heating fuel used												1978.9905	(219)
Annual totals kWh/year													
Space heating fuel - main system												3511.2964	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =										-1050.7868		-1050.7868	(233)
Total delivered energy for all uses												4983.0818	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3511.2964	3.9200	137.6428	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1978.9905	3.9200	77.5764	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	16.9600	-178.2134	(252)
Total energy cost			217.1973	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3511.2964	0.2160	758.4400	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9905	0.2160	427.4619	(264)
Space and water heating			1185.9020	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	0.5190	-545.3584	(269)
Total kg/year			922.6625	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3511.2964	1.2200	4283.7816	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9905	1.2200	2414.3684	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6698.1500 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1050.7868	3.0700	-3225.9156 (269)
Primary energy kWh/year			5141.0304 (272)
Primary energy kWh/m2/year			47.4177 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 32	-195 kg (21.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£32	1.80 kg/m²	B 90	A 92
Total Savings	£32	1.80 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£303	£263	£40
Space heating	£238	£238	£0
Water heating	£78	£46	£32
Lighting	£79	£79	£0
Generated (PV)	-£178	-£178	£0
Total cost of fuels	£217	£186	£32
Total cost of uses	£217	£185	£32
Delivered energy	46 kWh/m²	37 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	47 kWh/m²	37 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.6700	
Infiltration rate			0.3402	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4012	0.3934	0.3855	0.3462	0.3383	0.2990	0.2990	0.2911	0.3147	0.3383	0.3540	0.3698	(22b)
Effective ac	0.5805	0.5774	0.5743	0.5599	0.5572	0.5447	0.5447	0.5424	0.5495	0.5572	0.5627	0.5684	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8603	53.5703	53.2860	51.9509	51.7011	50.5382	50.5382	50.3229	50.9861	51.7011	52.2064	52.7347	(38)
Heat transfer coeff	123.6515	123.3615	123.0773	121.7421	121.4923	120.3294	120.3294	120.1141	120.7774	121.4923	121.9977	122.5260	(39)
Average = Sum(39)m / 12 =												121.7409	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1405	1.1378	1.1352	1.1229	1.1206	1.1098	1.1098	1.1079	1.1140	1.1206	1.1252	1.1301	(40)
HLP (average)												1.1229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2841	33.3623	33.4394	33.8061	33.8756	34.2030	34.2030	34.2643	34.0761	33.8756	33.7353	33.5898	
alpha	3.2189	3.2242	3.2293	3.2537	3.2584	3.2802	3.2802	3.2843	3.2717	3.2584	3.2490	3.2393	
util living area	0.9757	0.9653	0.9424	0.8899	0.7945	0.6491	0.5069	0.5538	0.7630	0.9145	0.9644	0.9788	(86)
MIT	19.1882	19.3809	19.7310	20.1932	20.5908	20.8540	20.9519	20.9350	20.7371	20.2239	19.6293	19.1509	(87)
Th 2	19.9679	19.9701	19.9722	19.9822	19.9841	19.9928	19.9928	19.9944	19.9894	19.9841	19.9803	19.9763	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9711	0.9589	0.9312	0.8674	0.7511	0.5741	0.4044	0.4512	0.6989	0.8924	0.9566	0.9748	(89)
MIT 2	17.5606	17.8402	18.3446	19.0033	19.5403	19.8681	19.9648	19.9537	19.7407	19.0599	18.2093	17.5118	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7840	18.0517	18.5349	19.1666	19.6845	20.0034	20.1003	20.0884	19.8775	19.2197	18.4042	17.7368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6340	17.9017	18.3849	19.0166	19.5345	19.8534	19.9503	19.9384	19.7275	19.0697	18.2542	17.5868	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9079	0.8410	0.7288	0.5627	0.3998	0.4450	0.6796	0.8663	0.9377	0.9610	(94)
Useful gains	711.9918	770.5947	817.5821	831.7621	760.6477	574.9232	389.7808	405.7861	570.5954	656.8528	668.6111	683.9160	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1648.7636	1603.9035	1462.7578	1231.6130	951.8308	632.1418	403.1380	425.0112	679.6723	1028.9983	1360.7820	1640.2265	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	696.9582	559.9835	480.0108	287.8926	142.2402	0.0000	0.0000	0.0000	0.0000	276.8762	498.3630	711.4950	(98)
Space heating												3653.8195	(98)
Space heating per m2											(98) / (4) =	33.7006	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4037.3696	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.9582	559.9835	480.0108	287.8926	142.2402	0.0000	0.0000	0.0000	0.0000	276.8762	498.3630	711.4950	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	770.1196	618.7663	530.3986	318.1134	157.1715	0.0000	0.0000	0.0000	0.0000	305.9405	550.6774	786.1823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9042	89.9392	89.9744	90.0373	90.1039	87.3000	87.3000	87.3000	87.3000	89.6612	89.8156	89.9175	(217)
Fuel for water heating, kWh/month													
	171.0806	127.6275	101.1478	52.1323	21.5148	4.4162	0.0000	31.2800	57.4574	105.8170	145.6115	169.8696	(219)
Water heating fuel used												987.9548	(219)
Annual totals kWh/year													
Space heating fuel - main system												4037.3696	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												4707.9246	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4037.3696	3.4800	140.5005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9548	3.4800	34.3808	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			253.0163	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6927	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	90.3375	
SAP rating (Section 12)	90	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4037.3696	0.2160	872.0718	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9548	0.2160	213.3982	(264)
Space and water heating			1085.4701	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			920.7396	(272)
CO2 emissions per m2			8.4900	(273)
EI value			91.9581	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.6700	
Infiltration rate				0.3402	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3147	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3304	0.3068	0.3147	0.2990	0.2990	0.2911	0.2832	0.2753	0.2675	0.2911	0.2753	0.2911	(22b)
Effective ac	0.5546	0.5471	0.5495	0.5447	0.5447	0.5424	0.5401	0.5379	0.5358	0.5424	0.5379	0.5424	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4570	50.7593	50.9861	50.5382	50.5382	50.3229	50.1133	49.9094	49.7113	50.3229	49.9094	50.3229	(38)
Heat transfer coeff	121.2483	120.5505	120.7774	120.3294	120.3294	120.1141	119.9045	119.7006	119.5025	120.1141	119.7006	120.1141	(39)
Average = Sum(39)m / 12 =												120.1988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1183	1.1119	1.1140	1.1098	1.1098	1.1079	1.1059	1.1040	1.1022	1.1079	1.1040	1.1079	(40)
HLP (average)												1.1086	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
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Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9438	34.1403	34.0761	34.2030	34.2030	34.2643	34.3242	34.3827	34.4397	34.2643	34.3827	34.2643	
alpha	3.2629	3.2760	3.2717	3.2802	3.2802	3.2843	3.2883	3.2922	3.2960	3.2843	3.2922	3.2843	
util living area	0.9705	0.9606	0.9315	0.8647	0.7502	0.5693	0.4327	0.4552	0.6994	0.8857	0.9532	0.9738	(86)
MIT	19.3566	19.5108	19.8718	20.3266	20.6955	20.9126	20.9735	20.9693	20.8217	20.3840	19.8227	19.3448	(87)
Th 2	19.9859	19.9911	19.9894	19.9928	19.9928	19.9944	19.9960	19.9975	19.9990	19.9944	19.9975	19.9944	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9649	0.9532	0.9181	0.8376	0.6986	0.4867	0.3290	0.3476	0.6244	0.8560	0.9428	0.9688 (89)
MIT 2	17.8156	18.0407	18.5562	19.1931	19.6791	19.9280	19.9832	19.9825	19.8439	19.2867	18.4981	17.8045 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0271	18.2425	18.7368	19.3487	19.8186	20.0631	20.1191	20.1179	19.9781	19.4373	18.6799	18.0159 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8771	18.0925	18.5868	19.1987	19.6686	19.9131	19.9691	19.9679	19.8281	19.2873	18.5299	17.8659 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6798	0.4796	0.3261	0.3443	0.6100	0.8297	0.9216	0.9532	(94)
Useful gains	728.6644	779.2432	829.0239	836.1908	724.7045	522.8711	337.8370	336.0819	543.0070	657.8395	683.9918	695.5301	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1573.4524	1542.1424	1399.4208	1167.0366	862.5918	554.1002	344.0162	343.2945	612.8167	947.3801	1272.4026	1545.3773	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	628.5223	512.6682	424.3753	238.2090	102.5882	0.0000	0.0000	0.0000	0.0000	215.4181	423.6558	632.2863	(98)
Space heating												3177.7232	(98)
Space heating per m2											(98) / (4) =	29.3094	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3511.2964	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	628.5223	512.6682	424.3753	238.2090	102.5882	0.0000	0.0000	0.0000	0.0000	215.4181	423.6558	632.2863	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	694.4998	566.4842	468.9230	263.2144	113.3571	0.0000	0.0000	0.0000	0.0000	238.0311	468.1280	698.6589	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8671	89.8968	89.9207	89.9702	89.8820	87.3000	87.3000	87.3000	87.3000	89.5277	89.7471	89.8699	(217)
Fuel for water heating, kWh/month	166.3209	127.7842	100.6377	50.6781	26.3534	0.0000	0.0000	23.8211	51.6488	101.3081	140.0984	166.3980	(219)
Water heating fuel used												955.0488	(219)

Annual totals kWh/year		
Space heating fuel - main system	3511.2964	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =	-1050.7868	-1050.7868 (233)
Total delivered energy for all uses	4009.1401	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3511.2964	3.9200	137.6428	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.0488	3.9200	37.4379	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	16.9600	-178.2134	(252)
Total energy cost			185.5387	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3511.2964	0.2160	758.4400 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.0488	0.2160	206.2905 (264)
Space and water heating			964.7306 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	468.5817	0.5190	243.1939 (268)
Energy saving/generation technologies			
PV Unit	-1050.7868	0.5190	-545.3584 (269)
Total kg/year			727.4411 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3511.2964	1.2200	4283.7816 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.0488	1.2200	1165.1595 (264)
Space and water heating			5448.9411 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1050.7868	3.0700	-3225.9156 (269)
Primary energy kWh/year			4045.3215 (272)
Primary energy kWh/m2/year			37.3116 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14 (P1)
Transmission heat loss coefficient	69.79 (37)
Summer heat loss coefficient	440.93 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-308	**Issued on Date**	10/02/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-Opp-SEMI
Property	11, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	89 B	**DER**	11.43	**TER**	17.43
Environmental	91 B	**% DER<TER**	34.42		
CO_2 Emissions (t/year)	0.90	**DFEE**	46.04	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.74		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.43 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.0 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 4.90 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/	(5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.9000	
Infiltration rate				0.3517	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4148	0.4067	0.3985	0.3579	0.3497	0.3091	0.3091	0.3009	0.3253	0.3497	0.3660	0.3823	(22b)
Effective ac	0.5860	0.5827	0.5794	0.5640	0.5612	0.5478	0.5478	0.5453	0.5529	0.5612	0.5670	0.5731	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3737	54.0638	53.7600	52.3330	52.0661	50.8233	50.8233	50.5931	51.3020	52.0661	52.6062	53.1708	(38)
Heat transfer coeff	124.1649	123.8550	123.5512	122.1243	121.8573	120.6145	120.6145	120.3843	121.0932	121.8573	122.3974	122.9620	(39)
Average = Sum(39)m / 12 =												122.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1452	1.1424	1.1396	1.1264	1.1239	1.1125	1.1125	1.1104	1.1169	1.1239	1.1289	1.1341	(40)
HLP (average)												1.1264	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1465	33.2294	33.3111	33.7003	33.7742	34.1222	34.1222	34.1874	33.9873	33.7742	33.6251	33.4707	
alpha	3.2098	3.2153	3.2207	3.2467	3.2516	3.2748	3.2748	3.2792	3.2658	3.2516	3.2417	3.2314	
util living area	0.9891	0.9812	0.9638	0.9228	0.8432	0.7117	0.5694	0.6179	0.8192	0.9471	0.9826	0.9910	(86)
MIT	18.9432	19.1697	19.5538	20.0531	20.4943	20.8052	20.9318	20.9095	20.6646	20.0776	19.4206	18.9052	(87)
Th 2	19.9641	19.9664	19.9687	19.9793	19.9813	19.9907	19.9907	19.9924	19.9871	19.9813	19.9773	19.9731	(88)
util rest of house	0.9870	0.9775	0.9562	0.9055	0.8053	0.6382	0.4600	0.5108	0.7620	0.9318	0.9785	0.9892	(89)
MIT 2	17.2039	17.5345	18.0919	18.8114	19.4199	19.8188	19.9496	19.9335	19.6585	18.8588	17.9085	17.1539	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4426	17.7589	18.2925	18.9818	19.5674	19.9541	20.0844	20.0674	19.7966	19.0261	18.1160	17.3942	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2926	17.6089	18.1425	18.8318	19.4174	19.8041	19.9344	19.9174	19.6466	18.8761	17.9660	17.2442	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9645	0.9371	0.8800	0.7800	0.6227	0.4533	0.5020	0.7386	0.9086	0.9660	0.9815	(94)
Useful gains	546.0286	630.4124	703.4457	744.8337	704.4644	550.5556	382.8001	396.0414	531.4312	565.2838	529.3712	516.2055	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1613.2261	1574.0613	1438.4483	1212.9153	940.4170	627.6953	402.1744	423.4431	671.6557	1008.4997	1329.9736	1603.9453	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	793.9950	634.1321	546.8419	337.0188	175.5487	0.0000	0.0000	0.0000	0.0000	329.7526	576.4337	809.2784	(98)
Space heating												4203.0012	(98)
Space heating per m2											(98) / (4) =	38.7659	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4644.2003	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	793.9950	634.1321	546.8419	337.0188	175.5487	0.0000	0.0000	0.0000	0.0000	329.7526	576.4337	809.2784	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	877.3425	700.6984	604.2452	372.3964	193.9765	0.0000	0.0000	0.0000	0.0000	364.3675	636.9434	894.2303	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8933	89.8461	89.7443	89.5198	89.0589	87.3000	87.3000	87.3000	87.3000	89.4793	89.7820	89.9168	(217)
Fuel for water heating, kWh/month													
	199.3171	174.8686	181.7298	160.3518	155.7810	138.8278	130.3257	147.1641	148.2179	166.5014	179.1756	193.4764	(219)
Water heating fuel used												1975.7374	(219)
Annual totals kWh/year													
Space heating fuel - main system												4644.2003	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												6252.5378	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4644.2003	0.2160	1003.1473	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7374	0.2160	426.7593	(264)
Space and water heating			1429.9065	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total CO2, kg/year			1239.2260	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4300	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		27.8655	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.8655	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
								Total per year (kWh/year) = Sum(64)m =				2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			4.9000	
Infiltration rate			0.3873	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3582	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4567	0.4478	0.4388	0.3940	0.3851	0.3403	0.3403	0.3314	0.3582	0.3851	0.4030	0.4209	(22b)
Effective ac	0.6043	0.6003	0.5963	0.5776	0.5741	0.5579	0.5579	0.5549	0.5642	0.5741	0.5812	0.5886	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.0696	55.6939	55.3255	53.5954	53.2717	51.7648	51.7648	51.4857	52.3452	53.2717	53.9265	54.6111	(38)
Heat transfer coeff	125.8609	125.4851	125.1167	123.3866	123.0629	121.5560	121.5560	121.2770	122.1365	123.0629	123.7178	124.4024	(39)
Average = Sum(39)m / 12 =												123.3851	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1609	1.1574	1.1540	1.1380	1.1351	1.1212	1.1212	1.1186	1.1265	1.1351	1.1411	1.1474	(40)
HLP (average)												1.1380	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2076	32.3041	32.3992	32.8535	32.9399	33.3482	33.3482	33.4250	33.1897	32.9399	32.7655	32.5852	
alpha	3.1472	3.1536	3.1599	3.1902	3.1960	3.2232	3.2232	3.2283	3.2126	3.1960	3.1844	3.1723	
util living area	0.9905	0.9832	0.9669	0.9281	0.8522	0.7244	0.5835	0.6339	0.8314	0.9523	0.9848	0.9922	(86)
MIT	18.8475	19.0799	19.4752	19.9943	20.4540	20.7852	20.9229	20.8976	20.6333	20.0198	19.3428	18.8140	(87)
Th 2	19.9514	19.9542	19.9570	19.9699	19.9723	19.9836	19.9836	19.9857	19.9792	19.9723	19.9674	19.9623	(88)
util rest of house	0.9886	0.9798	0.9599	0.9118	0.8157	0.6516	0.4727	0.5261	0.7763	0.9384	0.9812	0.9906	(89)
MIT 2	17.9770	18.2099	18.6032	19.1199	19.5558	19.8528	19.9514	19.9394	19.7313	19.1540	18.4823	17.9515	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0965	18.3293	18.7229	19.2399	19.6791	19.9808	20.0847	20.0709	19.8551	19.2728	18.6004	18.0698	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0965	18.3293	18.7229	19.2399	19.6791	19.9808	20.0847	20.0709	19.8551	19.2728	18.6004	18.0698	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8974	0.8035	0.6514	0.4847	0.5361	0.7683	0.9259	0.9745	0.9866	(94)
Useful gains	515.3350	603.0040	682.1593	733.1118	703.2365	559.1165	397.6751	408.8785	532.0071	548.6306	502.4564	485.6739	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1736.4409	1685.1762	1529.2845	1275.8108	981.9258	654.0654	423.5888	445.2010	702.9097	1067.3049	1422.8086	1725.4400	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	908.5028	727.2197	630.2612	390.7433	207.3449	0.0000	0.0000	0.0000	0.0000	385.8937	662.6536	922.3860	(98)
Space heating												4835.0051	(98)
Space heating per m2											(98) / (4) =	44.5951	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1142.6267	899.5147	921.7051	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7534	0.8239	0.7944	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	860.8395	741.1009	732.1826	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	182.1612	242.6861	200.8221	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												625.6693	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.5403	60.6715	50.2055	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.4173	(107)
Space cooling per m2												1.4427	(108)
Energy for space heating												44.5951	(99)
Energy for space cooling												1.4427	(108)
Total												46.0378	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)	
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)	
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)	
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.9000	
Infiltration rate		0.3517	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3416	0.3172	0.3253	0.3091	0.3091	0.3009	0.2928	0.2847	0.2765	0.3009	0.2847	0.3009	(22b)
Effective ac	0.5583	0.5503	0.5529	0.5478	0.5478	0.5453	0.5429	0.5405	0.5382	0.5453	0.5405	0.5453	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8052	51.0595	51.3020	50.8233	50.8233	50.5931	50.3691	50.1512	49.9395	50.5931	50.1512	50.5931	(38)
Heat transfer coeff	121.5965	120.8508	121.0932	120.6145	120.6145	120.3843	120.1603	119.9425	119.7307	120.3843	119.9425	120.3843	(39)
Average = Sum(39)m / 12 =												120.4749	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1147	1.1169	1.1125	1.1125	1.1104	1.1083	1.1063	1.1043	1.1104	1.1063	1.1104	(40)
HLP (average)												1.1112	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8466	34.0554	33.9873	34.1222	34.1222	34.1874	34.2511	34.3134	34.3740	34.1874	34.3134	34.1874	
alpha	3.2564	3.2704	3.2658	3.2748	3.2748	3.2792	3.2834	3.2876	3.2916	3.2792	3.2876	3.2792	
util living area	0.9665	0.9543	0.9216	0.8525	0.7395	0.5603	0.4235	0.4403	0.6745	0.8686	0.9459	0.9705	(86)
MIT	19.3961	19.5629	19.9230	20.3593	20.7080	20.9162	20.9749	20.9721	20.8400	20.4277	19.8687	19.3800	(87)
Th 2	19.9833	19.9889	19.9871	19.9907	19.9907	19.9924	19.9941	19.9957	19.9973	19.9924	19.9957	19.9924	(88)
util rest of house	0.9602	0.9459	0.9068	0.8238	0.6871	0.4781	0.3214	0.3352	0.5987	0.8360	0.9341	0.9649	(89)
MIT 2	17.8705	18.1133	18.6255	19.2339	19.6914	19.9290	19.9820	19.9821	19.8600	19.3414	18.5613	17.8537	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0799	18.3122	18.8035	19.3884	19.8309	20.0645	20.1183	20.1180	19.9945	19.4905	18.7407	18.0632	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9299	18.1622	18.6535	19.2384	19.6809	19.9145	19.9683	19.9680	19.8445	19.3405	18.5907	17.9132	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9252	0.8817	0.7984	0.6690	0.4714	0.3187	0.3321	0.5859	0.8100	0.9117	0.9483	(94)
Useful gains	759.8177	817.8573	865.9308	859.3049	733.9002	525.6267	338.8434	337.4663	553.5810	686.8201	716.7850	722.8372	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1584.3860	1554.4084	1411.1643	1174.5918	866.1244	555.5121	344.6564	343.9959	615.9560	955.9111	1282.2734	1554.5467 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	613.4788	494.9624	405.6537	227.0065	98.3748	0.0000	0.0000	0.0000	0.0000	200.2037	407.1517	618.7918 (98)
Space heating												3065.6236 (98)
RHI space heating demand												3066 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.9000	
Infiltration rate			0.3517	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4148	0.4067	0.3985	0.3579	0.3497	0.3091	0.3091	0.3009	0.3253	0.3497	0.3660	0.3823	(22b)
Effective ac	0.5860	0.5827	0.5794	0.5640	0.5612	0.5478	0.5478	0.5453	0.5529	0.5612	0.5670	0.5731	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3737	54.0638	53.7600	52.3330	52.0661	50.8233	50.8233	50.5931	51.3020	52.0661	52.6062	53.1708	(38)
Heat transfer coeff	124.1649	123.8550	123.5512	122.1243	121.8573	120.6145	120.6145	120.3843	121.0932	121.8573	122.3974	122.9620	(39)
Average = Sum(39)m / 12 =												122.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1452	1.1424	1.1396	1.1264	1.1239	1.1125	1.1125	1.1104	1.1169	1.1239	1.1289	1.1341	(40)
HLP (average)												1.1264	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1465	33.2294	33.3111	33.7003	33.7742	34.1222	34.1222	34.1874	33.9873	33.7742	33.6251	33.4707	
alpha	3.2098	3.2153	3.2207	3.2467	3.2516	3.2748	3.2748	3.2792	3.2658	3.2516	3.2417	3.2314	
util living area	0.9728	0.9598	0.9337	0.8786	0.7832	0.6386	0.4955	0.5361	0.7398	0.9012	0.9594	0.9765	(86)
MIT	19.2178	19.4300	19.7823	20.2298	20.6079	20.8604	20.9547	20.9406	20.7610	20.2684	19.6666	19.1774	(87)
Th 2	19.9641	19.9664	19.9687	19.9793	19.9813	19.9907	19.9907	19.9924	19.9871	19.9813	19.9773	19.9731	(88)
util rest of house	0.9678	0.9524	0.9211	0.8545	0.7386	0.5635	0.3943	0.4351	0.6736	0.8766	0.9507	0.9721	(89)
MIT 2	17.6007	17.9078	18.4140	19.0498	19.5585	19.8721	19.9645	19.9556	19.7640	19.1172	18.2603	17.5480	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8226	18.1167	18.6017	19.2117	19.7025	20.0077	20.1004	20.0908	19.9009	19.2752	18.4533	17.7716	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6726	17.9667	18.4517	19.0617	19.5525	19.8577	19.9504	19.9408	19.7509	19.1252	18.3033	17.6216	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8967	0.8280	0.7170	0.5527	0.3900	0.4295	0.6560	0.8500	0.9306	0.9574	(94)
Useful gains	738.8067	809.9617	856.8599	858.6542	773.5993	579.4993	391.5963	408.8011	585.3787	687.9433	697.9509	707.7426	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1660.4079	1618.3766	1476.6532	1240.9917	956.8889	634.1538	404.1095	426.2563	684.2808	1038.8617	1371.2535	1650.3467	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	685.6713	543.2548	461.1262	275.2830	136.3674	0.0000	0.0000	0.0000	0.0000	261.0833	484.7779	701.2975	(98)
Space heating												3548.8614	(98)
Space heating per m2											(98) / (4) =	32.7325	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3921.3938	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	685.6713	543.2548	461.1262	275.2830	136.3674	0.0000	0.0000	0.0000	0.0000	261.0833	484.7779	701.2975	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	757.6478	600.2816	509.5318	304.1801	150.6822	0.0000	0.0000	0.0000	0.0000	288.4898	535.6662	774.9143	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8179	89.7619	89.6415	89.3772	88.8574	87.3000	87.3000	87.3000	87.3000	89.3106	89.6810	89.8454	(217)
Fuel for water heating, kWh/month	199.4845	175.0326	181.9382	160.6078	156.1343	138.8278	130.3257	147.1641	148.2179	166.8159	179.3775	193.6302	(219)
Water heating fuel used												1977.5564	(219)
Annual totals kWh/year													
Space heating fuel - main system												3921.3938	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												5531.5504	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3921.3938	3.4800	136.4645	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5564	3.4800	68.8190	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			276.8234	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7578	(257)
SAP value		89.4283	
SAP rating (Section 12)		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3921.3938	0.2160	847.0211	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5564	0.2160	427.1522	(264)
Space and water heating			1274.1732	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			1083.4927	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	9.9900 (273)
EI value	90.5366
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.9000	
Infiltration rate				0.3517	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3416	0.3172	0.3253	0.3091	0.3091	0.3009	0.2928	0.2847	0.2765	0.3009	0.2847	0.3009	(22b)
Effective ac	0.5583	0.5503	0.5529	0.5478	0.5478	0.5453	0.5429	0.5405	0.5382	0.5453	0.5405	0.5453	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8052	51.0595	51.3020	50.8233	50.8233	50.5931	50.3691	50.1512	49.9395	50.5931	50.1512	50.5931	(38)
Heat transfer coeff	121.5965	120.8508	121.0932	120.6145	120.6145	120.3843	120.1603	119.9425	119.7307	120.3843	119.9425	120.3843	(39)
Average = Sum(39)m / 12 =												120.4749	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1147	1.1169	1.1125	1.1125	1.1104	1.1083	1.1063	1.1043	1.1104	1.1063	1.1104	(40)
HLP (average)												1.1112	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8466	34.0554	33.9873	34.1222	34.1222	34.1874	34.2511	34.3134	34.3740	34.1874	34.3134	34.1874	
alpha	3.2564	3.2704	3.2658	3.2748	3.2748	3.2792	3.2834	3.2876	3.2916	3.2792	3.2876	3.2792	
util living area	0.9665	0.9543	0.9216	0.8525	0.7395	0.5603	0.4235	0.4403	0.6745	0.8686	0.9459	0.9705	(86)
MIT	19.3961	19.5629	19.9230	20.3593	20.7080	20.9162	20.9749	20.9721	20.8400	20.4277	19.8687	19.3800	(87)
Th 2	19.9833	19.9889	19.9871	19.9907	19.9907	19.9924	19.9941	19.9957	19.9973	19.9924	19.9957	19.9924	(88)
util rest of house	0.9602	0.9459	0.9068	0.8238	0.6871	0.4781	0.3214	0.3352	0.5987	0.8360	0.9341	0.9649	(89)
MIT 2	17.8705	18.1133	18.6255	19.2339	19.6914	19.9290	19.9820	19.9821	19.8600	19.3414	18.5613	17.8537	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0799	18.3122	18.8035	19.3884	19.8309	20.0645	20.1183	20.1180	19.9945	19.4905	18.7407	18.0632	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9299	18.1622	18.6535	19.2384	19.6809	19.9145	19.9683	19.9680	19.8445	19.3405	18.5907	17.9132	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9252	0.8817	0.7984	0.6690	0.4714	0.3187	0.3321	0.5859	0.8100	0.9117	0.9483	(94)
Useful gains	759.8177	817.8573	865.9308	859.3049	733.9002	525.6267	338.8434	337.4663	553.5810	686.8201	716.7850	722.8372	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1584.3860	1554.4084	1411.1643	1174.5918	866.1244	555.5121	344.6564	343.9959	615.9560	955.9111	1282.2734	1554.5467	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	613.4788	494.9624	405.6537	227.0065	98.3748	0.0000	0.0000	0.0000	0.0000	200.2037	407.1517	618.7918	(98)
Space heating												3065.6236	(98)
Space heating per m2											(98) / (4) =	28.2754	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3387.4293	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	613.4788	494.9624	405.6537	227.0065	98.3748	0.0000	0.0000	0.0000	0.0000	200.2037	407.1517	618.7918	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	677.8772	546.9198	448.2362	250.8360	108.7014	0.0000	0.0000	0.0000	0.0000	221.2196	449.8913	683.7479	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7563	89.7077	89.5586	89.2329	88.5998	87.3000	87.3000	87.3000	87.3000	89.1064	89.5702	89.7778	(217)
Fuel for water heating, kWh/month	199.6214	175.1383	182.1066	160.8674	156.5884	138.8278	130.3257	147.1641	148.2179	167.1981	179.5993	193.7760	(219)
Water heating fuel used												1979.4309	(219)
Annual totals kWh/year													
Space heating fuel - main system												3387.4293	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =										-1050.7868		-1050.7868	(233)
Total delivered energy for all uses												4859.6552	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3387.4293	3.9200	132.7872	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4309	3.9200	77.5937	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	16.9600	-178.2134	(252)
Total energy cost			212.3589	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3387.4293	0.2160	731.6847	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4309	0.2160	427.5571	(264)
Space and water heating			1159.2418	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	0.5190	-545.3584	(269)
Total kg/year			896.0024	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3387.4293	1.2200	4132.6638	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4309	1.2200	2414.9057	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6547.5695 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1050.7868	3.0700	-3225.9156 (269)
Primary energy kWh/year			4990.4499 (272)
Primary energy kWh/m2/year			46.0289 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 32	-195 kg (21.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£32	1.80 kg/m²	B 90	A 92
Total Savings	£32	1.80 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£298	£258	£40
Space heating	£234	£234	£0
Water heating	£78	£46	£32
Lighting	£79	£79	£0
Generated (PV)	-£178	-£178	£0
Total cost of fuels	£212	£181	£32
Total cost of uses	£213	£181	£32
Delivered energy	45 kWh/m²	36 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	46 kWh/m²	36 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.9000	
Infiltration rate				0.3517	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4148	0.4067	0.3985	0.3579	0.3497	0.3091	0.3091	0.3009	0.3253	0.3497	0.3660	0.3823	(22b)
Effective ac	0.5860	0.5827	0.5794	0.5640	0.5612	0.5478	0.5478	0.5453	0.5529	0.5612	0.5670	0.5731	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3737	54.0638	53.7600	52.3330	52.0661	50.8233	50.8233	50.5931	51.3020	52.0661	52.6062	53.1708	(38)
Heat transfer coeff	124.1649	123.8550	123.5512	122.1243	121.8573	120.6145	120.6145	120.3843	121.0932	121.8573	122.3974	122.9620	(39)
Average = Sum(39)m / 12 =												122.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1452	1.1424	1.1396	1.1264	1.1239	1.1125	1.1125	1.1104	1.1169	1.1239	1.1289	1.1341	(40)
HLP (average)												1.1264	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1465	33.2294	33.3111	33.7003	33.7742	34.1222	34.1222	34.1874	33.9873	33.7742	33.6251	33.4707	
alpha	3.2098	3.2153	3.2207	3.2467	3.2516	3.2748	3.2748	3.2792	3.2658	3.2516	3.2417	3.2314	
util living area	0.9728	0.9598	0.9337	0.8786	0.7832	0.6386	0.4955	0.5361	0.7398	0.9012	0.9594	0.9765	(86)
MIT	19.2178	19.4300	19.7823	20.2298	20.6079	20.8604	20.9547	20.9406	20.7610	20.2684	19.6666	19.1774	(87)
Th 2	19.9641	19.9664	19.9687	19.9793	19.9813	19.9907	19.9907	19.9924	19.9871	19.9813	19.9773	19.9731	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9524	0.9211	0.8545	0.7386	0.5635	0.3943	0.4351	0.6736	0.8766	0.9507	0.9721	(89)
MIT 2	17.6007	17.9078	18.4140	19.0498	19.5585	19.8721	19.9645	19.9556	19.7640	19.1172	18.2603	17.5480	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8226	18.1167	18.6017	19.2117	19.7025	20.0077	20.1004	20.0908	19.9009	19.2752	18.4533	17.7716	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6726	17.9667	18.4517	19.0617	19.5525	19.8577	19.9504	19.9408	19.7509	19.1252	18.3033	17.6216	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8967	0.8280	0.7170	0.5527	0.3900	0.4295	0.6560	0.8500	0.9306	0.9574	(94)
Useful gains	738.8067	809.9617	856.8599	858.6542	773.5993	579.4993	391.5963	408.8011	585.3787	687.9433	697.9509	707.7426	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1660.4079	1618.3766	1476.6532	1240.9917	956.8889	634.1538	404.1095	426.2563	684.2808	1038.8617	1371.2535	1650.3467	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	685.6713	543.2548	461.1262	275.2830	136.3674	0.0000	0.0000	0.0000	0.0000	261.0833	484.7779	701.2975	(98)
Space heating												3548.8614	(98)
Space heating per m2											(98) / (4) =	32.7325	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3921.3938	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	685.6713	543.2548	461.1262	275.2830	136.3674	0.0000	0.0000	0.0000	0.0000	261.0833	484.7779	701.2975	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	757.6478	600.2816	509.5318	304.1801	150.6822	0.0000	0.0000	0.0000	0.0000	288.4898	535.6662	774.9143	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8963	89.9250	89.9565	90.0193	90.0890	87.3000	87.3000	87.3000	87.3000	89.6244	89.8007	89.9106	(217)
Fuel for water heating, kWh/month	171.0957	127.6476	101.1679	52.1427	21.5184	4.4162	0.0000	31.2800	57.4574	105.8605	145.6358	169.8826	(219)
Water heating fuel used												988.1049	(219)
Annual totals kWh/year													
Space heating fuel - main system												3921.3938	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												4592.0989	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3921.3938	3.4800	136.4645	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.1049	3.4800	34.3861	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			248.9855	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6816 (257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	90.4914	
SAP rating (Section 12)	90	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3921.3938	0.2160	847.0211	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.1049	0.2160	213.4307	(264)
Space and water heating			1060.4517	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			895.7212	(272)
CO2 emissions per m2			8.2600	(273)
EI value			92.1766	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.9000	
Infiltration rate				0.3517	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3253	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3416	0.3172	0.3253	0.3091	0.3091	0.3009	0.2928	0.2847	0.2765	0.3009	0.2847	0.3009	(22b)
Effective ac	0.5583	0.5503	0.5529	0.5478	0.5478	0.5453	0.5429	0.5405	0.5382	0.5453	0.5405	0.5453	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8052	51.0595	51.3020	50.8233	50.8233	50.5931	50.3691	50.1512	49.9395	50.5931	50.1512	50.5931	(38)
Heat transfer coeff	121.5965	120.8508	121.0932	120.6145	120.6145	120.3843	120.1603	119.9425	119.7307	120.3843	119.9425	120.3843	(39)
Average = Sum(39)m / 12 =												120.4749	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1147	1.1169	1.1125	1.1125	1.1104	1.1083	1.1063	1.1043	1.1104	1.1063	1.1104	(40)
HLP (average)												1.1112	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8466	34.0554	33.9873	34.1222	34.1222	34.1874	34.2511	34.3134	34.3740	34.1874	34.3134	34.1874	
alpha	3.2564	3.2704	3.2658	3.2748	3.2748	3.2792	3.2834	3.2876	3.2916	3.2792	3.2876	3.2792	
util living area	0.9665	0.9543	0.9216	0.8525	0.7395	0.5603	0.4235	0.4403	0.6745	0.8686	0.9459	0.9705	(86)
MIT	19.3961	19.5629	19.9230	20.3593	20.7080	20.9162	20.9749	20.9721	20.8400	20.4277	19.8687	19.3800	(87)
Th 2	19.9833	19.9889	19.9871	19.9907	19.9907	19.9924	19.9941	19.9957	19.9973	19.9924	19.9957	19.9924	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9602	0.9459	0.9068	0.8238	0.6871	0.4781	0.3214	0.3352	0.5987	0.8360	0.9341	0.9649	(89)
MIT 2	17.8705	18.1133	18.6255	19.2339	19.6914	19.9290	19.9820	19.9821	19.8600	19.3414	18.5613	17.8537	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0799	18.3122	18.8035	19.3884	19.8309	20.0645	20.1183	20.1180	19.9945	19.4905	18.7407	18.0632	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9299	18.1622	18.6535	19.2384	19.6809	19.9145	19.9683	19.9680	19.8445	19.3405	18.5907	17.9132	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9252	0.8817	0.7984	0.6690	0.4714	0.3187	0.3321	0.5859	0.8100	0.9117	0.9483	(94)
Useful gains	759.8177	817.8573	865.9308	859.3049	733.9002	525.6267	338.8434	337.4663	553.5810	686.8201	716.7850	722.8372	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1584.3860	1554.4084	1411.1643	1174.5918	866.1244	555.5121	344.6564	343.9959	615.9560	955.9111	1282.2734	1554.5467	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	613.4788	494.9624	405.6537	227.0065	98.3748	0.0000	0.0000	0.0000	0.0000	200.2037	407.1517	618.7918	(98)
Space heating												3065.6236	(98)
Space heating per m2											(98) / (4) =	28.2754	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3387.4293	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	613.4788	494.9624	405.6537	227.0065	98.3748	0.0000	0.0000	0.0000	0.0000	200.2037	407.1517	618.7918	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	677.8772	546.9198	448.2362	250.8360	108.7014	0.0000	0.0000	0.0000	0.0000	221.2196	449.8913	683.7479	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8547	89.8794	89.8990	89.9485	89.8608	87.3000	87.3000	87.3000	87.3000	89.4774	89.7240	89.8589	(217)
Fuel for water heating, kWh/month	166.3438	127.8090	100.6621	50.6903	26.3596	0.0000	0.0000	23.8211	51.6488	101.3650	140.1345	166.4183	(219)
Water heating fuel used												955.2525	(219)
Annual totals kWh/year													
Space heating fuel - main system												3387.4293	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =										-1050.7868		-1050.7868	(233)
Total delivered energy for all uses												3885.4768	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3387.4293	3.9200	132.7872	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.2525	3.9200	37.4459	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	16.9600	-178.2134	(252)
Total energy cost			180.6911	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3387.4293	0.2160	731.6847	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.2525	0.2160	206.3345	(264)
Space and water heating			938.0193	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	0.5190	-545.3584	(269)
Total kg/year			700.7298	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3387.4293	1.2200	4132.6638	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.2525	1.2200	1165.4081	(264)
Space and water heating			5298.0719	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	3.0700	-3225.9156	(269)
Primary energy kWh/year			3894.4522	(272)
Primary energy kWh/m2/year			35.9201	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.49	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-309	**Issued on Date**	14/03/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-As-SEMI
Property	13, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.92	**TER**	17.77
Environmental	91 B	**% DER<TER**	38.55		
CO_2 Emissions (t/year)	0.83	**DFEE**	47.17	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.34		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.92 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.2 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.65 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.6500	
Infiltration rate				0.3392	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4000	0.3922	0.3844	0.3451	0.3373	0.2981	0.2981	0.2902	0.3138	0.3373	0.3530	0.3687	(22b)
Effective ac	0.5800	0.5769	0.5739	0.5596	0.5569	0.5444	0.5444	0.5421	0.5492	0.5569	0.5623	0.5680	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8164	53.5281	53.2455	51.9182	51.6699	50.5139	50.5139	50.2998	50.9592	51.6699	52.1723	52.6975	(38)
Heat transfer coeff	123.6077	123.3194	123.0368	121.7095	121.4611	120.3051	120.3051	120.0910	120.7504	121.4611	121.9635	122.4887	(39)
Average = Sum(39)m / 12 =												121.7083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1401	1.1374	1.1348	1.1226	1.1203	1.1096	1.1096	1.1076	1.1137	1.1203	1.1249	1.1298	(40)
HLP (average)												1.1226	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	33.2959	33.3737	33.4504	33.8152	33.8843	34.2099	34.2099	34.2709	34.0838	33.8843	33.7447	33.6000	
alpha	3.2197	3.2249	3.2300	3.2543	3.2590	3.2807	3.2807	3.2847	3.2723	3.2590	3.2496	3.2400	
util living area	0.9908	0.9849	0.9703	0.9326	0.8545	0.7236	0.5838	0.6398	0.8431	0.9573	0.9857	0.9923	(86)
MIT	18.9117	19.1164	19.4961	20.0093	20.4718	20.7958	20.9270	20.9000	20.6302	20.0244	19.3797	18.8771	(87)
Th 2	19.9682	19.9704	19.9725	19.9824	19.9843	19.9930	19.9930	19.9946	19.9896	19.9843	19.9805	19.9766	(88)
util rest of house	0.9890	0.9818	0.9640	0.9170	0.8183	0.6509	0.4735	0.5322	0.7900	0.9446	0.9823	0.9908	(89)
MIT 2	17.1606	17.4599	18.0121	18.7535	19.3941	19.8114	19.9485	19.9285	19.6211	18.7869	17.8515	17.1152	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4009	17.6872	18.2157	18.9259	19.5420	19.9465	20.0828	20.0618	19.7596	18.9567	18.0612	17.3570	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2509	17.5372	18.0657	18.7759	19.3920	19.7965	19.9328	19.9118	19.6096	18.8067	17.9112	17.2070	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8924	0.7925	0.6347	0.4662	0.5223	0.7651	0.9233	0.9714	0.9840	(94)
Useful gains	516.7319	586.6551	658.5381	712.5955	687.9214	544.1218	380.0912	391.2021	510.1166	527.2546	496.3528	490.3449	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1600.8287	1558.4137	1423.0102	1201.9879	934.2810	625.1638	400.9559	421.7359	665.2867	996.7992	1318.5722	1593.2089	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	806.5680	653.0218	568.7672	352.3626	183.2915	0.0000	0.0000	0.0000	0.0000	349.3411	591.9980	820.5309	(98)
Space heating												4325.8811	(98)
Space heating per m2											(98) / (4) =	39.8993	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4779.9791	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	806.5680	653.0218	568.7672	352.3626	183.2915	0.0000	0.0000	0.0000	0.0000	349.3411	591.9980	820.5309	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	891.2354	721.5710	628.4721	389.3509	202.5321	0.0000	0.0000	0.0000	0.0000	386.0123	654.1414	906.6639	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9010	89.8612	89.7667	89.5499	89.0931	87.3000	87.3000	87.3000	87.3000	89.5190	89.7967	89.9234	(217)
Fuel for water heating, kWh/month	199.3001	174.8391	181.6844	160.2981	155.7214	138.8278	130.3257	147.1641	148.2179	166.4276	179.1463	193.4623	(219)
Water heating fuel used												1975.4147	(219)
Annual totals kWh/year													
Space heating fuel - main system												4779.9791	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6224.0761	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4779.9791	0.2160	1032.4755	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.4147	0.2160	426.6896	(264)
Space and water heating			1459.1651	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1183.4112	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.9200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.9200	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		27.3555	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.3555	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1423	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3748	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3467	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4420	0.4333	0.4247	0.3813	0.3727	0.3293	0.3293	0.3207	0.3467	0.3727	0.3900	0.4073	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5694	0.5542	0.5542	0.5514	0.5601	0.5694	0.5760	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.4550	55.1031	54.7581	53.1379	52.8347	51.4236	51.4236	51.1622	51.9671	52.8347	53.4480	54.0891	(38)
Heat transfer coeff	125.2462	124.8943	124.5494	122.9291	122.6260	121.2148	121.2148	120.9535	121.7584	122.6260	123.2392	123.8804	(39)
Average = Sum(39)m / 12 =												122.9277	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1552	1.1519	1.1488	1.1338	1.1310	1.1180	1.1180	1.1156	1.1230	1.1310	1.1367	1.1426	(40)
HLP (average)												1.1338	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3657	32.4569	32.5468	32.9757	33.0573	33.4421	33.4421	33.5144	33.2928	33.0573	32.8928	32.7225	
alpha	3.1577	3.1638	3.1698	3.1984	3.2038	3.2295	3.2295	3.2343	3.2195	3.2038	3.1929	3.1815	
util living area	0.9920	0.9866	0.9731	0.9375	0.8633	0.7364	0.5983	0.6563	0.8549	0.9620	0.9877	0.9934	(86)
MIT	18.8164	19.0266	19.4171	19.9497	20.4306	20.7751	20.9175	20.8870	20.5968	19.9653	19.3018	18.7863	(87)
Th 2	19.9560	19.9586	19.9612	19.9733	19.9756	19.9862	19.9862	19.9881	19.9821	19.9756	19.9710	19.9662	(88)
util rest of house	0.9904	0.9839	0.9673	0.9230	0.8285	0.6645	0.4867	0.5483	0.8042	0.9505	0.9847	0.9921	(89)
MIT 2	17.9494	18.1604	18.5496	19.0806	19.5384	19.8481	19.9513	19.9362	19.7047	19.1047	18.4444	17.9267	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.0684	18.2793	18.6686	19.1999	19.6609	19.9754	20.0839	20.0667	19.8271	19.2228	18.5621	18.0447	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0684	18.2793	18.6686	19.1999	19.6609	19.9754	20.0839	20.0667	19.8271	19.2228	18.5621	18.0447	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9777	0.9576	0.9091	0.8159	0.6637	0.4984	0.5577	0.7948	0.9392	0.9789	0.9885	(94)
Useful gains	485.4636	558.0930	635.5550	699.1160	685.4056	551.9030	394.4340	403.0839	508.3982	508.5216	468.5163	459.3647	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1724.4422	1670.9950	1515.5929	1266.1534	976.2071	651.5721	422.3055	443.5033	697.3235	1057.3788	1412.5816	1715.0848	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	921.8000	747.8702	654.7482	408.2669	216.3564	0.0000	0.0000	0.0000	0.0000	408.3498	679.7270	934.2558	(98)
Space heating												4971.3742	(98)
Space heating per m2											(98) / (4) =	45.8529	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1139.4191	896.9895	919.2463	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7437	0.8144	0.7784	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	847.3558	730.5450	715.5030	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	169.3677	225.1782	178.5025	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												573.0484	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.3419	56.2945	44.6256	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												143.2621	(107)
Space cooling per m2												1.3214	(108)
Energy for space heating												45.8529	(99)
Energy for space cooling												1.3214	(108)
Total												47.1743	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b)	= 106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c)	= 112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d)	= 62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3392	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3294	0.3059	0.3138	0.2981	0.2981	0.2902	0.2824	0.2745	0.2667	0.2902	0.2745	0.2902	(22b)
Effective ac	0.5543	0.5468	0.5492	0.5444	0.5444	0.5421	0.5399	0.5377	0.5356	0.5421	0.5377	0.5421	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4273	50.7337	50.9592	50.5139	50.5139	50.2998	50.0914	49.8888	49.6918	50.2998	49.8888	50.2998	(38)
Heat transfer coeff	121.2185	120.5249	120.7504	120.3051	120.3051	120.0910	119.8827	119.6800	119.4830	120.0910	119.6800	120.0910	(39)
Average = Sum(39)m / 12 =												120.1752	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1180	1.1116	1.1137	1.1096	1.1096	1.1076	1.1057	1.1039	1.1020	1.1076	1.1039	1.1076	(40)
HLP (average)												1.1084	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9521	34.1475	34.0838	34.2099	34.2099	34.2709	34.3305	34.3886	34.4453	34.2709	34.3886	34.2709	
alpha	3.2635	3.2765	3.2723	3.2807	3.2807	3.2847	3.2887	3.2926	3.2964	3.2847	3.2926	3.2847	
util living area	0.9705	0.9606	0.9314	0.8646	0.7502	0.5692	0.4326	0.4552	0.6993	0.8857	0.9532	0.9738	(86)
MIT	19.3571	19.5112	19.8723	20.3269	20.6957	20.9126	20.9735	20.9694	20.8218	20.3842	19.8230	19.3452	(87)
Th 2	19.9861	19.9913	19.9896	19.9930	19.9930	19.9946	19.9962	19.9977	19.9992	19.9946	19.9977	19.9946	(88)
util rest of house	0.9649	0.9532	0.9181	0.8375	0.6986	0.4867	0.3290	0.3476	0.6243	0.8560	0.9428	0.9688	(89)
MIT 2	17.8165	18.0415	18.5569	19.1936	19.6795	19.9282	19.9833	19.9827	19.8441	19.2872	18.4986	17.8052	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0280	18.2432	18.7375	19.3492	19.8189	20.0633	20.1192	20.1181	19.9783	19.4378	18.6804	18.0166	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8780	18.0932	18.5875	19.1992	19.6689	19.9133	19.9692	19.9681	19.8283	19.2878	18.5304	17.8666	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6797	0.4795	0.3261	0.3442	0.6099	0.8297	0.9216	0.9532	(94)
Useful gains	728.6629	779.2398	829.0132	836.1645	724.6566	522.8151	337.7988	336.0468	542.9715	657.8236	683.9883	695.5294	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1573.1680	1541.9004	1399.1906	1166.8607	862.4588	554.0183	343.9721	343.2530	612.7421	947.2481	1272.2424	1545.1582 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	628.3118	512.5079	424.2120	238.1012	102.5248	0.0000	0.0000	0.0000	0.0000	215.3318	423.5430	632.1238 (98)
Space heating												3176.6565 (98)
RHI space heating demand												3177 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3392	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4000	0.3922	0.3844	0.3451	0.3373	0.2981	0.2981	0.2902	0.3138	0.3373	0.3530	0.3687	(22b)
Effective ac	0.5800	0.5769	0.5739	0.5596	0.5569	0.5444	0.5444	0.5421	0.5492	0.5569	0.5623	0.5680	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8164	53.5281	53.2455	51.9182	51.6699	50.5139	50.5139	50.2998	50.9592	51.6699	52.1723	52.6975	(38)
Heat transfer coeff	123.6077	123.3194	123.0368	121.7095	121.4611	120.3051	120.3051	120.0910	120.7504	121.4611	121.9635	122.4887	(39)
Average = Sum(39)m / 12 =												121.7083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1401	1.1374	1.1348	1.1226	1.1203	1.1096	1.1096	1.1076	1.1137	1.1203	1.1249	1.1298	(40)
HLP (average)												1.1226	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2959	33.3737	33.4504	33.8152	33.8843	34.2099	34.2099	34.2709	34.0838	33.8843	33.7447	33.6000	
alpha	3.2197	3.2249	3.2300	3.2543	3.2590	3.2807	3.2807	3.2847	3.2723	3.2590	3.2496	3.2400	
util living area	0.9757	0.9653	0.9424	0.8898	0.7945	0.6490	0.5068	0.5537	0.7630	0.9145	0.9644	0.9788	(86)
MIT	19.1890	19.3816	19.7316	20.1937	20.5911	20.8541	20.9519	20.9350	20.7373	20.2242	19.6298	19.1515	(87)
Th 2	19.9682	19.9704	19.9725	19.9824	19.9843	19.9930	19.9930	19.9946	19.9896	19.9843	19.9805	19.9766	(88)
util rest of house	0.9711	0.9588	0.9312	0.8674	0.7510	0.5740	0.4044	0.4511	0.6989	0.8923	0.9566	0.9748	(89)
MIT 2	17.5619	17.8415	18.3457	19.0040	19.5409	19.8684	19.9650	19.9539	19.7411	19.0606	18.2102	17.5129	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7852	18.0528	18.5359	19.1673	19.6850	20.0037	20.1005	20.0886	19.8778	19.2203	18.4050	17.7378	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6352	17.9028	18.3859	19.0173	19.5350	19.8537	19.9505	19.9386	19.7278	19.0703	18.2550	17.5878	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9079	0.8409	0.7287	0.5626	0.3998	0.4450	0.6796	0.8662	0.9377	0.9610	(94)
Useful gains	711.9913	770.5913	817.5709	831.7362	760.5973	574.8691	389.7344	405.7430	570.5562	656.8390	668.6083	683.9161	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1648.3338	1603.5010	1462.4053	1231.3694	951.6472	632.0441	403.0788	424.9517	679.5609	1028.8082	1360.5046	1639.8591	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	696.6388	559.7154	479.7568	287.7359	142.1411	0.0000	0.0000	0.0000	0.0000	276.7450	498.1654	711.2216	(98)
Space heating												3652.1199	(98)
Space heating per m2											(98) / (4) =	33.6849	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4035.4916	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	696.6388	559.7154	479.7568	287.7359	142.1411	0.0000	0.0000	0.0000	0.0000	276.7450	498.1654	711.2216	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	769.7666	618.4700	530.1180	317.9402	157.0620	0.0000	0.0000	0.0000	0.0000	305.7956	550.4590	785.8802	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8264	89.7787	89.6661	89.4092	88.8906	87.3000	87.3000	87.3000	87.3000	89.3538	89.6974	89.8527	(217)
Fuel for water heating, kWh/month	199.4656	174.9998	181.8882	160.5503	156.0761	138.8278	130.3257	147.1641	148.2179	166.7352	179.3445	193.6145	(219)
Water heating fuel used												1977.2097	(219)
Annual totals kWh/year													
Space heating fuel - main system												4035.4916	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5481.3836	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4035.4916	3.4800	140.4351	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.2097	3.4800	68.8069	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			259.1612	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7095	(257)
SAP value		90.1028	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4035.4916	0.2160	871.6662	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.2097	0.2160	427.0773	(264)
Space and water heating			1298.7435	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			1022.9896	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	9.4400 (273)
EI value	91.0650
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/	(5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.6500	
Infiltration rate				0.3392	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3294	0.3059	0.3138	0.2981	0.2981	0.2902	0.2824	0.2745	0.2667	0.2902	0.2745	0.2902	(22b)
Effective ac	0.5543	0.5468	0.5492	0.5444	0.5444	0.5421	0.5399	0.5377	0.5356	0.5421	0.5377	0.5421	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4273	50.7337	50.9592	50.5139	50.5139	50.2998	50.0914	49.8888	49.6918	50.2998	49.8888	50.2998	(38)
Heat transfer coeff	121.2185	120.5249	120.7504	120.3051	120.3051	120.0910	119.8827	119.6800	119.4830	120.0910	119.6800	120.0910	(39)
Average = Sum(39)m / 12 =												120.1752	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1180	1.1116	1.1137	1.1096	1.1096	1.1076	1.1057	1.1039	1.1020	1.1076	1.1039	1.1076	(40)
HLP (average)												1.1084	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9521	34.1475	34.0838	34.2099	34.2099	34.2709	34.3305	34.3886	34.4453	34.2709	34.3886	34.2709	
alpha	3.2635	3.2765	3.2723	3.2807	3.2807	3.2847	3.2887	3.2926	3.2964	3.2847	3.2926	3.2847	
util living area	0.9705	0.9606	0.9314	0.8646	0.7502	0.5692	0.4326	0.4552	0.6993	0.8857	0.9532	0.9738	(86)
MIT	19.3571	19.5112	19.8723	20.3269	20.6957	20.9126	20.9735	20.9694	20.8218	20.3842	19.8230	19.3452	(87)
Th 2	19.9861	19.9913	19.9896	19.9930	19.9930	19.9946	19.9962	19.9977	19.9992	19.9946	19.9977	19.9946	(88)
util rest of house	0.9649	0.9532	0.9181	0.8375	0.6986	0.4867	0.3290	0.3476	0.6243	0.8560	0.9428	0.9688	(89)
MIT 2	17.8165	18.0415	18.5569	19.1936	19.6795	19.9282	19.9833	19.9827	19.8441	19.2872	18.4986	17.8052	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0280	18.2432	18.7375	19.3492	19.8189	20.0633	20.1192	20.1181	19.9783	19.4378	18.6804	18.0166	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8780	18.0932	18.5875	19.1992	19.6689	19.9133	19.9692	19.9681	19.8283	19.2878	18.5304	17.8666	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6797	0.4795	0.3261	0.3442	0.6099	0.8297	0.9216	0.9532	(94)
Useful gains	728.6629	779.2398	829.0132	836.1645	724.6566	522.8151	337.7988	336.0468	542.9715	657.8236	683.9883	695.5294	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1573.1680	1541.9004	1399.1906	1166.8607	862.4588	554.0183	343.9721	343.2530	612.7421	947.2481	1272.2424	1545.1582	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	628.3118	512.5079	424.2120	238.1012	102.5248	0.0000	0.0000	0.0000	0.0000	215.3318	423.5430	632.1238	(98)
Space heating												3176.6565	(98)
Space heating per m2											(98) / (4) =	29.2995	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3510.1176	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	628.3118	512.5079	424.2120	238.1012	102.5248	0.0000	0.0000	0.0000	0.0000	215.3318	423.5430	632.1238	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	694.2672	566.3071	468.7425	263.0953	113.2871	0.0000	0.0000	0.0000	0.0000	237.9357	468.0033	698.4794	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7699	89.7283	89.5881	89.2693	88.6318	87.3000	87.3000	87.3000	87.3000	89.1635	89.5960	89.7897	(217)
Fuel for water heating, kWh/month													
	199.5913	175.0981	182.0467	160.8019	156.5318	138.8278	130.3257	147.1641	148.2179	167.0912	179.5476	193.7504	(219)
Water heating fuel used												1978.9945	(219)
Annual totals kWh/year													
Space heating fuel - main system												3510.1176	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4811.9692	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3510.1176	9.7400	341.8855	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1978.9945	9.7400	192.7541	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			389.1124	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3510.1176	0.2160	758.1854	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9945	0.2160	427.4628	(264)
Space and water heating			1185.6482	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			834.2110	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3510.1176	1.2200	4282.3435	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9945	1.2200	2414.3733	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6696.7168 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			4617.8880 (272)
Primary energy kWh/m2/year			42.5926 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (23.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	1.80 kg/m²	B 91	A 93
Total Savings	£81	1.80 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 512 TEST (15 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£200	£219	-£18
Mains gas	£639	£539	£100
Space heating	£474	£474	£0
Water heating	£193	£111	£81
Lighting	£173	£173	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£389	£308	£82
Total cost of uses	£390	£308	£81
Delivered energy	44 kWh/m²	35 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	32 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.6500	
Infiltration rate			0.3392	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4000	0.3922	0.3844	0.3451	0.3373	0.2981	0.2981	0.2902	0.3138	0.3373	0.3530	0.3687	(22b)
Effective ac	0.5800	0.5769	0.5739	0.5596	0.5569	0.5444	0.5444	0.5421	0.5492	0.5569	0.5623	0.5680	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8164	53.5281	53.2455	51.9182	51.6699	50.5139	50.5139	50.2998	50.9592	51.6699	52.1723	52.6975	(38)
Heat transfer coeff	123.6077	123.3194	123.0368	121.7095	121.4611	120.3051	120.3051	120.0910	120.7504	121.4611	121.9635	122.4887	(39)
Average = Sum(39)m / 12 =												121.7083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1401	1.1374	1.1348	1.1226	1.1203	1.1096	1.1096	1.1076	1.1137	1.1203	1.1249	1.1298	(40)
HLP (average)												1.1226	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
									Solar input (sum of months) = Sum(63)m =			-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
									Total per year (kWh/year) = Sum(64)m =			885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2959	33.3737	33.4504	33.8152	33.8843	34.2099	34.2099	34.2709	34.0838	33.8843	33.7447	33.6000	
alpha	3.2197	3.2249	3.2300	3.2543	3.2590	3.2807	3.2807	3.2847	3.2723	3.2590	3.2496	3.2400	
util living area	0.9757	0.9653	0.9424	0.8898	0.7945	0.6490	0.5068	0.5537	0.7630	0.9145	0.9644	0.9788	(86)
MIT	19.1890	19.3816	19.7316	20.1937	20.5911	20.8541	20.9519	20.9350	20.7373	20.2242	19.6298	19.1515	(87)
Th 2	19.9682	19.9704	19.9725	19.9824	19.9843	19.9930	19.9930	19.9946	19.9896	19.9843	19.9805	19.9766	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9711	0.9588	0.9312	0.8674	0.7510	0.5740	0.4044	0.4511	0.6989	0.8923	0.9566	0.9748	(89)
MIT 2	17.5619	17.8415	18.3457	19.0040	19.5409	19.8684	19.9650	19.9539	19.7411	19.0606	18.2102	17.5129	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7852	18.0528	18.5359	19.1673	19.6850	20.0037	20.1005	20.0886	19.8778	19.2203	18.4050	17.7378	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6352	17.9028	18.3859	19.0173	19.5350	19.8537	19.9505	19.9386	19.7278	19.0703	18.2550	17.5878	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9079	0.8409	0.7287	0.5626	0.3998	0.4450	0.6796	0.8662	0.9377	0.9610	(94)
Useful gains	711.9913	770.5913	817.5709	831.7362	760.5973	574.8691	389.7344	405.7430	570.5562	656.8390	668.6083	683.9161	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1648.3338	1603.5010	1462.4053	1231.3694	951.6472	632.0441	403.0788	424.9517	679.5609	1028.8082	1360.5046	1639.8591	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	696.6388	559.7154	479.7568	287.7359	142.1411	0.0000	0.0000	0.0000	0.0000	276.7450	498.1654	711.2216	(98)
Space heating												3652.1199	(98)
Space heating per m2											(98) / (4) =	33.6849	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4035.4916	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.6388	559.7154	479.7568	287.7359	142.1411	0.0000	0.0000	0.0000	0.0000	276.7450	498.1654	711.2216	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	769.7666	618.4700	530.1180	317.9402	157.0620	0.0000	0.0000	0.0000	0.0000	305.7956	550.4590	785.8802	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9040	89.9390	89.9741	90.0371	90.1036	87.3000	87.3000	87.3000	87.3000	89.6609	89.8154	89.9173	(217)
Fuel for water heating, kWh/month													
	171.0810	127.6278	101.1481	52.1324	21.5149	4.4162	0.0000	31.2800	57.4574	105.8174	145.6119	169.8699	(219)
Water heating fuel used												987.9570	(219)
Annual totals kWh/year													
Space heating fuel - main system												4035.4916	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4542.1309	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4035.4916	3.4800	140.4351	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9570	3.4800	34.3809	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			231.3302	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6333	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	91.1657	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4035.4916	0.2160	871.6662	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9570	0.2160	213.3987	(264)
Space and water heating			1085.0649	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			835.2610	(272)
CO2 emissions per m2			7.7000	(273)
EI value			92.7047	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.6500	
Infiltration rate			0.3392	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3138	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3294	0.3059	0.3138	0.2981	0.2981	0.2902	0.2824	0.2745	0.2667	0.2902	0.2745	0.2902	(22b)
Effective ac	0.5543	0.5468	0.5492	0.5444	0.5444	0.5421	0.5399	0.5377	0.5356	0.5421	0.5377	0.5421	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.4273	50.7337	50.9592	50.5139	50.5139	50.2998	50.0914	49.8888	49.6918	50.2998	49.8888	50.2998	(38)
Heat transfer coeff	121.2185	120.5249	120.7504	120.3051	120.3051	120.0910	119.8827	119.6800	119.4830	120.0910	119.6800	120.0910	(39)
Average = Sum(39)m / 12 =												120.1752	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1180	1.1116	1.1137	1.1096	1.1096	1.1076	1.1057	1.1039	1.1020	1.1076	1.1039	1.1076	(40)
HLP (average)												1.1084	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9521	34.1475	34.0838	34.2099	34.2099	34.2709	34.3305	34.3886	34.4453	34.2709	34.3886	34.2709	
alpha	3.2635	3.2765	3.2723	3.2807	3.2807	3.2847	3.2887	3.2926	3.2964	3.2847	3.2926	3.2847	
util living area	0.9705	0.9606	0.9314	0.8646	0.7502	0.5692	0.4326	0.4552	0.6993	0.8857	0.9532	0.9738	(86)
MIT	19.3571	19.5112	19.8723	20.3269	20.6957	20.9126	20.9735	20.9694	20.8218	20.3842	19.8230	19.3452	(87)
Th 2	19.9861	19.9913	19.9896	19.9930	19.9930	19.9946	19.9962	19.9977	19.9992	19.9946	19.9977	19.9946	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9649	0.9532	0.9181	0.8375	0.6986	0.4867	0.3290	0.3476	0.6243	0.8560	0.9428	0.9688	(89)
MIT 2	17.8165	18.0415	18.5569	19.1936	19.6795	19.9282	19.9833	19.9827	19.8441	19.2872	18.4986	17.8052	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0280	18.2432	18.7375	19.3492	19.8189	20.0633	20.1192	20.1181	19.9783	19.4378	18.6804	18.0166	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8780	18.0932	18.5875	19.1992	19.6689	19.9133	19.9692	19.9681	19.8283	19.2878	18.5304	17.8666	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8939	0.8117	0.6797	0.4795	0.3261	0.3442	0.6099	0.8297	0.9216	0.9532	(94)
Useful gains	728.6629	779.2398	829.0132	836.1645	724.6566	522.8151	337.7988	336.0468	542.9715	657.8236	683.9883	695.5294	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1573.1680	1541.9004	1399.1906	1166.8607	862.4588	554.0183	343.9721	343.2530	612.7421	947.2481	1272.2424	1545.1582	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	628.3118	512.5079	424.2120	238.1012	102.5248	0.0000	0.0000	0.0000	0.0000	215.3318	423.5430	632.1238	(98)
Space heating												3176.6565	(98)
Space heating per m2											(98) / (4) =	29.2995	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3510.1176	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	628.3118	512.5079	424.2120	238.1012	102.5248	0.0000	0.0000	0.0000	0.0000	215.3318	423.5430	632.1238	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	694.2672	566.3071	468.7425	263.0953	113.2871	0.0000	0.0000	0.0000	0.0000	237.9357	468.0033	698.4794	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8670	89.8967	89.9205	89.9700	89.8817	87.3000	87.3000	87.3000	87.3000	89.5274	89.7470	89.8698	(217)
Fuel for water heating, kWh/month													
	166.3212	127.7845	100.6379	50.6782	26.3535	0.0000	0.0000	23.8211	51.6488	101.3084	140.0986	166.3982	(219)
Water heating fuel used												955.0505	(219)
Annual totals kWh/year													
Space heating fuel - main system												3510.1176	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3838.0252	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3510.1176	9.7400	341.8855	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.0505	9.7400	93.0219	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			307.8052	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3510.1176	0.2160	758.1854 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.0505	0.2160	206.2909 (264)
Space and water heating			964.4763 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	468.5817	0.5190	243.1939 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	0.5190	-633.5561 (269)
Total kg/year			638.9891 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3510.1176	1.2200	4282.3435 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.0505	1.2200	1165.1616 (264)
Space and water heating			5447.5051 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			3522.1764 (272)
Primary energy kWh/m2/year			32.4864 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14 (P1)
Transmission heat loss coefficient	69.79 (37)
Summer heat loss coefficient	440.93 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-310	**Issued on Date**	23/02/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-Opp-SEMI
Property	15, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.62	**TER**	17.43
Environmental	91 B	**% DER<TER**	39.07		
CO_2 Emissions (t/year)	0.81	**DFEE**	45.90	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.00		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.62 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.76 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/	(5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.7600	
Infiltration rate				0.3447	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4065	0.3986	0.3906	0.3507	0.3428	0.3029	0.3029	0.2949	0.3188	0.3428	0.3587	0.3746	(22b)
Effective ac	0.5826	0.5794	0.5763	0.5615	0.5587	0.5459	0.5459	0.5435	0.5508	0.5587	0.5643	0.5702	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0591	53.7614	53.4696	52.0989	51.8425	50.6486	50.6486	50.4275	51.1085	51.8425	52.3613	52.9036	(38)
Heat transfer coeff	123.8504	123.5527	123.2608	121.8901	121.6337	120.4399	120.4399	120.2188	120.8997	121.6337	122.1525	122.6949	(39)
Average = Sum(39)m / 12 =												121.8889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1423	1.1396	1.1369	1.1242	1.1219	1.1109	1.1109	1.1088	1.1151	1.1219	1.1267	1.1317	(40)
HLP (average)												1.1242	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2306	33.3107	33.3896	33.7651	33.8362	34.1716	34.1716	34.2345	34.0417	33.8362	33.6925	33.5436	
alpha	3.2154	3.2207	3.2260	3.2510	3.2557	3.2781	3.2781	3.2823	3.2694	3.2557	3.2462	3.2362	
util living area	0.9891	0.9812	0.9637	0.9226	0.8429	0.7113	0.5688	0.6174	0.8189	0.9470	0.9826	0.9910	(86)
MIT	18.9486	19.1748	19.5583	20.0562	20.4965	20.8062	20.9323	20.9100	20.6660	20.0802	19.4242	18.9098	(87)
Th 2	19.9664	19.9686	19.9708	19.9811	19.9830	19.9920	19.9920	19.9936	19.9885	19.9830	19.9791	19.9751	(88)
util rest of house	0.9870	0.9774	0.9562	0.9053	0.8050	0.6378	0.4596	0.5104	0.7617	0.9318	0.9785	0.9892	(89)
MIT 2	17.2132	17.5433	18.0998	18.8169	19.4239	19.8209	19.9511	19.9350	19.6613	18.8635	17.9148	17.1618	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4513	17.7672	18.3000	18.9870	19.5711	19.9561	20.0858	20.0688	19.7992	19.0305	18.1220	17.4017	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3013	17.6172	18.1500	18.8370	19.4211	19.8061	19.9358	19.9188	19.6492	18.8805	17.9720	17.2517	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9645	0.9371	0.8799	0.7798	0.6224	0.4530	0.5016	0.7383	0.9086	0.9660	0.9815	(94)
Useful gains	546.0399	630.4169	703.4211	744.7347	704.2237	550.2517	382.5058	395.7768	531.2394	565.2456	529.3755	516.2152	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1610.2209	1571.2431	1435.9831	1211.2220	939.1504	627.0202	401.7600	423.0290	670.8907	1007.1830	1328.0393	1601.3757	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	791.7506	632.2352	545.0261	335.8708	174.7855	0.0000	0.0000	0.0000	0.0000	328.8014	575.0379	807.3594	(98)
Space heating												4190.8670	(98)
Space heating per m2											(98) / (4) =	38.6540	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4630.7923	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	791.7506	632.2352	545.0261	335.8708	174.7855	0.0000	0.0000	0.0000	0.0000	328.8014	575.0379	807.3594	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	874.8626	698.6024	602.2388	371.1280	193.1332	0.0000	0.0000	0.0000	0.0000	363.3165	635.4010	892.1098	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8919	89.8445	89.7424	89.5175	89.0555	87.3000	87.3000	87.3000	87.3000	89.4773	89.7806	89.9157	(217)
Fuel for water heating, kWh/month													
	199.3202	174.8716	181.7337	160.3560	155.7871	138.8278	130.3257	147.1641	148.2179	166.5051	179.1783	193.4788	(219)
Water heating fuel used												1975.7664	(219)
Annual totals kWh/year													
Space heating fuel - main system												4630.7923	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6075.2410	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4630.7923	0.2160	1000.2511	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7664	0.2160	426.7656	(264)
Space and water heating			1427.0167	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1151.2628	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.6200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.6200	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		27.0555	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.0555	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
								Total per year (kWh/year) = Sum(64)m =				2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				4.7600	
Infiltration rate				0.3803	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3517	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4485	0.4397	0.4309	0.3869	0.3781	0.3342	0.3342	0.3254	0.3517	0.3781	0.3957	0.4133	(22b)
Effective ac	0.6006	0.5967	0.5928	0.5749	0.5715	0.5558	0.5558	0.5529	0.5619	0.5715	0.5783	0.5854	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7230	55.3606	55.0055	53.3373	53.0252	51.5723	51.5723	51.3033	52.1320	53.0252	53.6566	54.3167	(38)
Heat transfer coeff	125.5142	125.1519	124.7967	123.1286	122.8165	121.3636	121.3636	121.0945	121.9232	122.8165	123.4478	124.1079	(39)
Average = Sum(39)m / 12 =												123.1271	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1577	1.1543	1.1510	1.1357	1.1328	1.1194	1.1194	1.1169	1.1245	1.1328	1.1386	1.1447	(40)
HLP (average)												1.1356	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2966	32.3901	32.4822	32.9223	33.0060	33.4011	33.4011	33.4753	33.2478	33.0060	32.8372	32.6625	
alpha	3.1531	3.1593	3.1655	3.1948	3.2004	3.2267	3.2267	3.2317	3.2165	3.2004	3.1891	3.1775	
util living area	0.9905	0.9832	0.9669	0.9280	0.8519	0.7240	0.5829	0.6333	0.8311	0.9522	0.9848	0.9922	(86)
MIT	18.8534	19.0855	19.4802	19.9978	20.4564	20.7863	20.9234	20.8981	20.6348	20.0226	19.3467	18.8191	(87)
Th 2	19.9540	19.9567	19.9594	19.9718	19.9741	19.9850	19.9850	19.9871	19.9808	19.9741	19.9694	19.9645	(88)
util rest of house	0.9886	0.9798	0.9599	0.9116	0.8154	0.6512	0.4723	0.5257	0.7760	0.9383	0.9812	0.9906	(89)
MIT 2	17.9848	18.2172	18.6098	19.1247	19.5594	19.8549	19.9530	19.9411	19.7339	19.1581	18.4877	17.9581	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.1040	18.3364	18.7293	19.2445	19.6825	19.9827	20.0862	20.0724	19.8576	19.2768	18.6056	18.0762	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1040	18.3364	18.7293	19.2445	19.6825	19.9827	20.0862	20.0724	19.8576	19.2768	18.6056	18.0762	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8973	0.8032	0.6510	0.4843	0.5357	0.7680	0.9258	0.9745	0.9866	(94)
Useful gains	515.3440	603.0074	682.1356	733.0133	702.9898	558.7950	397.3511	408.5924	531.8137	548.5956	502.4599	485.6815	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1732.5959	1681.5913	1526.1751	1273.7072	980.3872	653.2642	423.0978	444.7094	701.9812	1065.6494	1420.3425	1722.1491	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	905.6354	724.8084	627.9654	389.2996	206.3836	0.0000	0.0000	0.0000	0.0000	384.6881	660.8755	919.9319	(98)
Space heating												4819.5879	(98)
Space heating per m2											(98) / (4) =	44.4529	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1140.8175	898.0904	920.3182	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7542	0.8246	0.7951	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	860.4010	740.5758	731.7523	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	182.4768	243.0767	201.1422	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												626.6958	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.6192	60.7692	50.2856	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.6739	(107)
Space cooling per m2												1.4451	(108)
Energy for space heating												44.4529	(99)
Energy for space cooling												1.4451	(108)
Total												45.8980	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)	
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)	
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)	
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.3447	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3348	0.3109	0.3188	0.3029	0.3029	0.2949	0.2870	0.2790	0.2710	0.2949	0.2790	0.2949	(22b)
Effective ac	0.5560	0.5483	0.5508	0.5459	0.5459	0.5435	0.5412	0.5389	0.5367	0.5435	0.5389	0.5435	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5919	50.8756	51.1085	50.6486	50.6486	50.4275	50.2124	50.0031	49.7997	50.4275	50.0031	50.4275	(38)
Heat transfer coeff	121.3831	120.6668	120.8997	120.4399	120.4399	120.2188	120.0036	119.7943	119.5909	120.2188	119.7943	120.2188	(39)
Average = Sum(39)m / 12 =												120.3057	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1196	1.1130	1.1151	1.1109	1.1109	1.1088	1.1068	1.1049	1.1030	1.1088	1.1049	1.1088	(40)
HLP (average)												1.1096	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9061	34.1074	34.0417	34.1716	34.1716	34.2345	34.2959	34.3558	34.4142	34.2345	34.3558	34.2345	
alpha	3.2604	3.2738	3.2694	3.2781	3.2781	3.2823	3.2864	3.2904	3.2943	3.2823	3.2904	3.2823	
util living area	0.9665	0.9543	0.9215	0.8522	0.7391	0.5598	0.4231	0.4398	0.6741	0.8684	0.9459	0.9705	(86)
MIT	19.3998	19.5661	19.9260	20.3614	20.7093	20.9167	20.9751	20.9722	20.8407	20.4293	19.8708	19.3829	(87)
Th 2	19.9849	19.9903	19.9885	19.9920	19.9920	19.9936	19.9953	19.9968	19.9984	19.9936	19.9968	19.9936	(88)
util rest of house	0.9602	0.9458	0.9067	0.8236	0.6867	0.4778	0.3212	0.3349	0.5984	0.8358	0.9340	0.9649	(89)
MIT 2	17.8769	18.1187	18.6306	19.2377	19.6940	19.9306	19.9833	19.9833	19.8616	19.3446	18.5651	17.8587	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0859	18.3173	18.8084	19.3919	19.8334	20.0659	20.1194	20.1191	19.9960	19.4934	18.7443	18.0679	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9359	18.1673	18.6584	19.2419	19.6834	19.9159	19.9694	19.9691	19.8460	19.3434	18.5943	17.9179	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7982	0.6687	0.4710	0.3184	0.3319	0.5856	0.8098	0.9116	0.9483	(94)
Useful gains	759.8006	817.8225	865.8320	859.0901	733.5369	525.2172	338.5667	337.2095	553.3005	686.6775	716.7499	722.8284	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1582.3367	1552.6609	1409.4979	1173.3181	865.1640	554.9227	344.3396	343.6973	615.4130	954.9510	1281.1153	1552.9685 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	611.9669	493.8115	404.4875	226.2442	97.9306	0.0000	0.0000	0.0000	0.0000	199.5955	406.3431	617.6242 (98)
Space heating												3058.0033 (98)
RHI space heating demand												3058 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.7600	
Infiltration rate		0.3447	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4065	0.3986	0.3906	0.3507	0.3428	0.3029	0.3029	0.2949	0.3188	0.3428	0.3587	0.3746	(22b)
Effective ac	0.5826	0.5794	0.5763	0.5615	0.5587	0.5459	0.5459	0.5435	0.5508	0.5587	0.5643	0.5702	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9654	(36)
Total fabric heat loss	(33) + (36) = 69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0591	53.7614	53.4696	52.0989	51.8425	50.6486	50.6486	50.4275	51.1085	51.8425	52.3613	52.9036	(38)
Heat transfer coeff	123.8504	123.5527	123.2608	121.8901	121.6337	120.4399	120.4399	120.2188	120.8997	121.6337	122.1525	122.6949	(39)
Average = Sum(39)m / 12 =												121.8889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1423	1.1396	1.1369	1.1242	1.1219	1.1109	1.1109	1.1088	1.1151	1.1219	1.1267	1.1317	(40)
HLP (average)												1.1242	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2306	33.3107	33.3896	33.7651	33.8362	34.1716	34.1716	34.2345	34.0417	33.8362	33.6925	33.5436	
alpha	3.2154	3.2207	3.2260	3.2510	3.2557	3.2781	3.2781	3.2823	3.2694	3.2557	3.2462	3.2362	
util living area	0.9728	0.9597	0.9335	0.8783	0.7828	0.6381	0.4950	0.5356	0.7393	0.9011	0.9594	0.9765	(86)
MIT	19.2234	19.4352	19.7869	20.2328	20.6099	20.8611	20.9550	20.9410	20.7622	20.2709	19.6703	19.1822	(87)
Th 2	19.9664	19.9686	19.9708	19.9811	19.9830	19.9920	19.9920	19.9936	19.9885	19.9830	19.9791	19.9751	(88)
util rest of house	0.9678	0.9523	0.9209	0.8543	0.7382	0.5631	0.3939	0.4347	0.6732	0.8764	0.9506	0.9721	(89)
MIT 2	17.6102	17.9168	18.4219	19.0551	19.5623	19.8740	19.9660	19.9571	19.7666	19.1219	18.2668	17.5561	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8316	18.1252	18.6092	19.2168	19.7061	20.0095	20.1017	20.0921	19.9032	19.2796	18.4594	17.7793	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6816	17.9752	18.4592	19.0668	19.5561	19.8595	19.9517	19.9421	19.7532	19.1296	18.3094	17.6293	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8966	0.8278	0.7167	0.5523	0.3897	0.4292	0.6556	0.8498	0.9305	0.9574	(94)
Useful gains	738.7977	809.9232	856.7536	858.4370	773.2097	579.0980	391.2570	408.4807	585.0596	687.8161	697.9220	707.7400	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1657.3154	1615.4729	1474.1041	1239.2283	955.5618	633.4495	403.6834	425.8273	683.4695	1037.4820	1369.2537	1647.7047	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	683.3772	541.3294	459.3088	274.1698	135.6700	0.0000	0.0000	0.0000	0.0000	260.1514	483.3588	699.3337	(98)
Space heating												3536.6990	(98)
Space heating per m2											(98) / (4) =	32.6204	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3907.9547	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	683.3772	541.3294	459.3088	274.1698	135.6700	0.0000	0.0000	0.0000	0.0000	260.1514	483.3588	699.3337	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	755.1129	598.1540	507.5235	302.9500	149.9116	0.0000	0.0000	0.0000	0.0000	287.4601	534.0981	772.7444	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8161	89.7599	89.6390	89.3742	88.8533	87.3000	87.3000	87.3000	87.3000	89.3079	89.6792	89.8440	(217)
Fuel for water heating, kWh/month													
	199.4885	175.0365	181.9433	160.6131	156.1415	138.8278	130.3257	147.1641	148.2179	166.8209	179.3810	193.6334	(219)
Water heating fuel used												1977.5936	(219)
Annual totals kWh/year													
Space heating fuel - main system												3907.9547	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5354.2306	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3907.9547	3.4800	135.9968	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5936	3.4800	68.8203	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			254.7363	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6974	(257)
SAP value		90.2718	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3907.9547	0.2160	844.1182	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5936	0.2160	427.1602	(264)
Space and water heating			1271.2784	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			995.5246	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	9.1800 (273)
EI value	91.3049
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.7600	
Infiltration rate				0.3447	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3348	0.3109	0.3188	0.3029	0.3029	0.2949	0.2870	0.2790	0.2710	0.2949	0.2790	0.2949	(22b)
Effective ac	0.5560	0.5483	0.5508	0.5459	0.5459	0.5435	0.5412	0.5389	0.5367	0.5435	0.5389	0.5435	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5919	50.8756	51.1085	50.6486	50.6486	50.4275	50.2124	50.0031	49.7997	50.4275	50.0031	50.4275	(38)
Heat transfer coeff	121.3831	120.6668	120.8997	120.4399	120.4399	120.2188	120.0036	119.7943	119.5909	120.2188	119.7943	120.2188	(39)
Average = Sum(39)m / 12 =												120.3057	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1196	1.1130	1.1151	1.1109	1.1109	1.1088	1.1068	1.1049	1.1030	1.1088	1.1049	1.1088	(40)
HLP (average)												1.1096	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9061	34.1074	34.0417	34.1716	34.1716	34.2345	34.2959	34.3558	34.4142	34.2345	34.3558	34.2345	
alpha	3.2604	3.2738	3.2694	3.2781	3.2781	3.2823	3.2864	3.2904	3.2943	3.2823	3.2904	3.2823	
util living area	0.9665	0.9543	0.9215	0.8522	0.7391	0.5598	0.4231	0.4398	0.6741	0.8684	0.9459	0.9705	(86)
MIT	19.3998	19.5661	19.9260	20.3614	20.7093	20.9167	20.9751	20.9722	20.8407	20.4293	19.8708	19.3829	(87)
Th 2	19.9849	19.9903	19.9885	19.9920	19.9920	19.9936	19.9953	19.9968	19.9984	19.9936	19.9968	19.9936	(88)
util rest of house	0.9602	0.9458	0.9067	0.8236	0.6867	0.4778	0.3212	0.3349	0.5984	0.8358	0.9340	0.9649	(89)
MIT 2	17.8769	18.1187	18.6306	19.2377	19.6940	19.9306	19.9833	19.9833	19.8616	19.3446	18.5651	17.8587	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0859	18.3173	18.8084	19.3919	19.8334	20.0659	20.1194	20.1191	19.9960	19.4934	18.7443	18.0679	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9359	18.1673	18.6584	19.2419	19.6834	19.9159	19.9694	19.9691	19.8460	19.3434	18.5943	17.9179	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7982	0.6687	0.4710	0.3184	0.3319	0.5856	0.8098	0.9116	0.9483	(94)
Useful gains	759.8006	817.8225	865.8320	859.0901	733.5369	525.2172	338.5667	337.2095	553.3005	686.6775	716.7499	722.8284	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1582.3367	1552.6609	1409.4979	1173.3181	865.1640	554.9227	344.3396	343.6973	615.4130	954.9510	1281.1153	1552.9685	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	611.9669	493.8115	404.4875	226.2442	97.9306	0.0000	0.0000	0.0000	0.0000	199.5955	406.3431	617.6242	(98)
Space heating												3058.0033	(98)
Space heating per m2											(98) / (4) =	28.2052	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3379.0092	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	611.9669	493.8115	404.4875	226.2442	97.9306	0.0000	0.0000	0.0000	0.0000	199.5955	406.3431	617.6242	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	676.2065	545.6480	446.9475	249.9936	108.2106	0.0000	0.0000	0.0000	0.0000	220.5475	448.9979	682.4577	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7549	89.7063	89.5567	89.2303	88.5963	87.3000	87.3000	87.3000	87.3000	89.1040	89.5689	89.7768	(217)
Fuel for water heating, kWh/month	199.6245	175.1410	182.1104	160.8721	156.5946	138.8278	130.3257	147.1641	148.2179	167.2026	179.6019	193.7782	(219)
Water heating fuel used												1979.4609	(219)
Annual totals kWh/year													
Space heating fuel - main system												3379.0092	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4681.3272	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3379.0092	3.6300	122.6580	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4609	3.6300	71.8544	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	468.5817	19.4400	91.0923	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	19.4400	-237.3089	(252)
Total energy cost			157.8759	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3379.0092	0.2160	729.8660	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4609	0.2160	427.5635	(264)
Space and water heating			1157.4295	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			805.9924	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3379.0092	1.2200	4122.3912	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4609	1.2200	2414.9423	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6537.3335 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			4458.5048 (272)
Primary energy kWh/m2/year			41.1225 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 27	-195 kg (24.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£27	1.80 kg/m²	B 91	A 93
Total Savings	£27	1.80 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£106	£115	-£10
Mains gas	£290	£252	£37
Space heating	£232	£232	£0
Water heating	£72	£44	£27
Lighting	£91	£91	£0
Generated (PV)	-£237	-£237	£0
Total cost of fuels	£159	£130	£27
Total cost of uses	£158	£130	£27
Delivered energy	43 kWh/m²	34 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	6 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	31 kWh/m²	10 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.3447	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4065	0.3986	0.3906	0.3507	0.3428	0.3029	0.3029	0.2949	0.3188	0.3428	0.3587	0.3746	(22b)
Effective ac	0.5826	0.5794	0.5763	0.5615	0.5587	0.5459	0.5459	0.5435	0.5508	0.5587	0.5643	0.5702	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0591	53.7614	53.4696	52.0989	51.8425	50.6486	50.6486	50.4275	51.1085	51.8425	52.3613	52.9036	(38)
Heat transfer coeff	123.8504	123.5527	123.2608	121.8901	121.6337	120.4399	120.4399	120.2188	120.8997	121.6337	122.1525	122.6949	(39)
Average = Sum(39)m / 12 =												121.8889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1423	1.1396	1.1369	1.1242	1.1219	1.1109	1.1109	1.1088	1.1151	1.1219	1.1267	1.1317	(40)
HLP (average)												1.1242	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2306	33.3107	33.3896	33.7651	33.8362	34.1716	34.1716	34.2345	34.0417	33.8362	33.6925	33.5436	
alpha	3.2154	3.2207	3.2260	3.2510	3.2557	3.2781	3.2781	3.2823	3.2694	3.2557	3.2462	3.2362	
util living area	0.9728	0.9597	0.9335	0.8783	0.7828	0.6381	0.4950	0.5356	0.7393	0.9011	0.9594	0.9765	(86)
MIT	19.2234	19.4352	19.7869	20.2328	20.6099	20.8611	20.9550	20.9410	20.7622	20.2709	19.6703	19.1822	(87)
Th 2	19.9664	19.9686	19.9708	19.9811	19.9830	19.9920	19.9920	19.9936	19.9885	19.9830	19.9791	19.9751	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9523	0.9209	0.8543	0.7382	0.5631	0.3939	0.4347	0.6732	0.8764	0.9506	0.9721	(89)
MIT 2	17.6102	17.9168	18.4219	19.0551	19.5623	19.8740	19.9660	19.9571	19.7666	19.1219	18.2668	17.5561	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8316	18.1252	18.6092	19.2168	19.7061	20.0095	20.1017	20.0921	19.9032	19.2796	18.4594	17.7793	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6816	17.9752	18.4592	19.0668	19.5561	19.8595	19.9517	19.9421	19.7532	19.1296	18.3094	17.6293	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8966	0.8278	0.7167	0.5523	0.3897	0.4292	0.6556	0.8498	0.9305	0.9574	(94)
Useful gains	738.7977	809.9232	856.7536	858.4370	773.2097	579.0980	391.2570	408.4807	585.0596	687.8161	697.9220	707.7400	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1657.3154	1615.4729	1474.1041	1239.2283	955.5618	633.4495	403.6834	425.8273	683.4695	1037.4820	1369.2537	1647.7047	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	683.3772	541.3294	459.3088	274.1698	135.6700	0.0000	0.0000	0.0000	0.0000	260.1514	483.3588	699.3337	(98)
Space heating												3536.6990	(98)
Space heating per m2											(98) / (4) =	32.6204	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3907.9547	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	683.3772	541.3294	459.3088	274.1698	135.6700	0.0000	0.0000	0.0000	0.0000	260.1514	483.3588	699.3337	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	755.1129	598.1540	507.5235	302.9500	149.9116	0.0000	0.0000	0.0000	0.0000	287.4601	534.0981	772.7444	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8946	89.9233	89.9547	90.0177	90.0872	87.3000	87.3000	87.3000	87.3000	89.6221	89.7990	89.9092	(217)
Fuel for water heating, kWh/month													
	171.0989	127.6500	101.1699	52.1437	21.5188	4.4162	0.0000	31.2800	57.4574	105.8632	145.6384	169.8852	(219)
Water heating fuel used												988.1217	(219)
Annual totals kWh/year													
Space heating fuel - main system												3907.9547	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4414.7587	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3907.9547	3.4800	135.9968	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.1217	3.4800	34.3866	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			226.8977	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6212	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	91.3349	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3907.9547	0.2160	844.1182	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.1217	0.2160	213.4343	(264)
Space and water heating			1057.5525	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			807.7486	(272)
CO2 emissions per m2			7.4500	(273)
EI value			92.9450	
EI rating			93	(274)
EI band			A	

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.3447	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3188	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3348	0.3109	0.3188	0.3029	0.3029	0.2949	0.2870	0.2790	0.2710	0.2949	0.2790	0.2949	(22b)
Effective ac	0.5560	0.5483	0.5508	0.5459	0.5459	0.5435	0.5412	0.5389	0.5367	0.5435	0.5389	0.5435	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5919	50.8756	51.1085	50.6486	50.6486	50.4275	50.2124	50.0031	49.7997	50.4275	50.0031	50.4275	(38)
Heat transfer coeff	121.3831	120.6668	120.8997	120.4399	120.4399	120.2188	120.0036	119.7943	119.5909	120.2188	119.7943	120.2188	(39)
Average = Sum(39)m / 12 =												120.3057	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1196	1.1130	1.1151	1.1109	1.1109	1.1088	1.1068	1.1049	1.1030	1.1088	1.1049	1.1088	(40)
HLP (average)												1.1096	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9061	34.1074	34.0417	34.1716	34.1716	34.2345	34.2959	34.3558	34.4142	34.2345	34.3558	34.2345	
alpha	3.2604	3.2738	3.2694	3.2781	3.2781	3.2823	3.2864	3.2904	3.2943	3.2823	3.2904	3.2823	
util living area	0.9665	0.9543	0.9215	0.8522	0.7391	0.5598	0.4231	0.4398	0.6741	0.8684	0.9459	0.9705	(86)
MIT	19.3998	19.5661	19.9260	20.3614	20.7093	20.9167	20.9751	20.9722	20.8407	20.4293	19.8708	19.3829	(87)
Th 2	19.9849	19.9903	19.9885	19.9920	19.9920	19.9936	19.9953	19.9968	19.9984	19.9936	19.9968	19.9936	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9602	0.9458	0.9067	0.8236	0.6867	0.4778	0.3212	0.3349	0.5984	0.8358	0.9340	0.9649	(89)
MIT 2	17.8769	18.1187	18.6306	19.2377	19.6940	19.9306	19.9833	19.9833	19.8616	19.3446	18.5651	17.8587	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.0859	18.3173	18.8084	19.3919	19.8334	20.0659	20.1194	20.1191	19.9960	19.4934	18.7443	18.0679	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9359	18.1673	18.6584	19.2419	19.6834	19.9159	19.9694	19.9691	19.8460	19.3434	18.5943	17.9179	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7982	0.6687	0.4710	0.3184	0.3319	0.5856	0.8098	0.9116	0.9483	(94)
Useful gains	759.8006	817.8225	865.8320	859.0901	733.5369	525.2172	338.5667	337.2095	553.3005	686.6775	716.7499	722.8284	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1582.3367	1552.6609	1409.4979	1173.3181	865.1640	554.9227	344.3396	343.6973	615.4130	954.9510	1281.1153	1552.9685	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	611.9669	493.8115	404.4875	226.2442	97.9306	0.0000	0.0000	0.0000	0.0000	199.5955	406.3431	617.6242	(98)
Space heating												3058.0033	(98)
Space heating per m2											(98) / (4) =	28.2052	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3379.0092 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	611.9669	493.8115	404.4875	226.2442	97.9306	0.0000	0.0000	0.0000	0.0000	199.5955	406.3431	617.6242	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	676.2065	545.6480	446.9475	249.9936	108.2106	0.0000	0.0000	0.0000	0.0000	220.5475	448.9979	682.4577	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8535	89.8782	89.8976	89.9470	89.8585	87.3000	87.3000	87.3000	87.3000	89.4753	89.7228	89.8580	(217)
Fuel for water heating, kWh/month													
	166.3462	127.8106	100.6636	50.6912	26.3603	0.0000	0.0000	23.8211	51.6488	101.3674	140.1363	166.4201	(219)
Water heating fuel used												955.2657	(219)
Annual totals kWh/year													
Space heating fuel - main system												3379.0092	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3707.1320	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3379.0092	3.6300	122.6580	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.2657	3.6300	34.6761	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	468.5817	19.4400	91.0923	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	19.4400	-237.3089	(252)
Total energy cost			130.4176	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3379.0092	0.2160	729.8660 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.2657	0.2160	206.3374 (264)
Space and water heating			936.2034 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	468.5817	0.5190	243.1939 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	0.5190	-633.5561 (269)
Total kg/year			610.7162 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3379.0092	1.2200	4122.3912 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.2657	1.2200	1165.4241 (264)
Space and water heating			5287.8154 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			3362.4866 (272)
Primary energy kWh/m2/year			31.0135 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14 (P1)
Transmission heat loss coefficient	69.79 (37)
Summer heat loss coefficient	440.93 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	125.2818	0.4600	0.0000	0.9000	213.6906
South	2.4700	118.5567	0.4600	0.0000	0.9000	121.2337
West	6.6700	125.2818	0.4600	0.0000	0.9000	345.9506
total:						680.8749

	Jun	Jul	Aug	
Solar gains	729	681	611	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1236	1166	1107	(P5)
Summer gain/loss ratio	2.80	2.64	2.51	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.25	20.99	20.85	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-311	**Issued on Date**	14/03/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-As-SEMI
Property	17, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	91 B	**DER**	9.98	**TER**	17.77
Environmental	92 A	**% DER<TER**	43.84		
CO_2 Emissions (t/year)	0.73	**DFEE**	47.38	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.97		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.98 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.4 kWh/m²/yrOK
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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.86 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.8600	
Infiltration rate			0.3497	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4124	0.4043	0.3963	0.3558	0.3477	0.3073	0.3073	0.2992	0.3235	0.3477	0.3639	0.3801	(22b)
Effective ac	0.5850	0.5817	0.5785	0.5633	0.5605	0.5472	0.5472	0.5448	0.5523	0.5605	0.5662	0.5722	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2832	53.9768	53.6764	52.2657	52.0017	50.7730	50.7730	50.5455	51.2463	52.0017	52.5357	53.0939	(38)
Heat transfer coeff	124.0744	123.7680	123.4677	122.0569	121.7930	120.5642	120.5642	120.3367	121.0375	121.7930	122.3269	122.8852	(39)
Average = Sum(39)m / 12 =												122.0556	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1416	1.1388	1.1258	1.1233	1.1120	1.1120	1.1099	1.1164	1.1233	1.1283	1.1334	(40)
HLP (average)												1.1258	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1706	33.2528	33.3336	33.7189	33.7920	34.1364	34.1364	34.2009	34.0029	33.7920	33.6445	33.4917	
alpha	3.2114	3.2169	3.2222	3.2479	3.2528	3.2758	3.2758	3.2801	3.2669	3.2528	3.2430	3.2328	
util living area	0.9908	0.9849	0.9704	0.9327	0.8549	0.7243	0.5846	0.6405	0.8435	0.9574	0.9857	0.9923	(86)
MIT	18.9037	19.1088	19.4894	20.0047	20.4686	20.7944	20.9264	20.8992	20.6282	20.0206	19.3744	18.8703	(87)
Th 2	19.9647	19.9670	19.9693	19.9798	19.9818	19.9910	19.9910	19.9927	19.9875	19.9818	19.9778	19.9736	(88)
util rest of house	0.9889	0.9818	0.9640	0.9172	0.8187	0.6514	0.4740	0.5327	0.7904	0.9447	0.9823	0.9908	(89)
MIT 2	17.1469	17.4469	18.0004	18.7453	19.3881	19.8082	19.9462	19.9261	19.6169	18.7800	17.8421	17.1035	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.3880	17.6750	18.2048	18.9182	19.5363	19.9436	20.0807	20.0597	19.7557	18.9502	18.0524	17.3460	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2380	17.5250	18.0548	18.7682	19.3863	19.7936	19.9307	19.9097	19.6057	18.8002	17.9024	17.1960	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8926	0.7929	0.6352	0.4668	0.5228	0.7654	0.9234	0.9713	0.9839	(94)
Useful gains	516.7148	586.6429	658.5555	712.7088	688.2390	544.5484	380.5134	391.5705	510.3467	527.2883	496.3435	490.3308	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1605.2726	1562.5701	1426.6388	1204.4769	936.1432	626.1580	401.5673	422.3437	666.3998	998.7302	1321.4270	1597.0103	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	809.8870	655.8231	571.4540	354.0731	184.4407	0.0000	0.0000	0.0000	0.0000	350.7527	594.0601	823.3696	(98)
Space heating												4343.8602	(98)
Space heating per m2											(98) / (4) =	40.0651	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4799.8456	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	809.8870	655.8231	571.4540	354.0731	184.4407	0.0000	0.0000	0.0000	0.0000	350.7527	594.0601	823.3696	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	894.9027	724.6664	631.4408	391.2410	203.8018	0.0000	0.0000	0.0000	0.0000	387.5721	656.4200	909.8006	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9030	89.8634	89.7694	89.5531	89.0980	87.3000	87.3000	87.3000	87.3000	89.5217	89.7986	89.9250	(217)
Fuel for water heating, kWh/month	199.2956	174.8349	181.6790	160.2923	155.7128	138.8278	130.3257	147.1641	148.2179	166.4225	179.1425	193.4588	(219)
Water heating fuel used												1975.3738	(219)
Annual totals kWh/year													
Space heating fuel - main system												4799.8456	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												6040.6440	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4799.8456	0.2160	1036.7666	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.3738	0.2160	426.6807	(264)
Space and water heating			1463.4474	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1082.2028	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.9800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.9800	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		26.4155	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.4155	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

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Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				4.8600	
Infiltration rate				0.3853	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3564	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4544	0.4455	0.4366	0.3920	0.3831	0.3386	0.3386	0.3296	0.3564	0.3831	0.4009	0.4187	(22b)
Effective ac	0.6032	0.5992	0.5953	0.5768	0.5734	0.5573	0.5573	0.5543	0.5635	0.5734	0.5804	0.5877	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.9699	55.5980	55.2335	53.5212	53.2008	51.7094	51.7094	51.4333	52.2839	53.2008	53.8489	54.5265	(38)
Heat transfer coeff	125.7612	125.3893	125.0247	123.3124	122.9920	121.5007	121.5007	121.2245	122.0751	122.9920	123.6401	124.3177	(39)
Average = Sum(39)m / 12 =												123.3109	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1599	1.1565	1.1532	1.1374	1.1344	1.1206	1.1206	1.1181	1.1259	1.1344	1.1404	1.1466	(40)
HLP (average)												1.1373	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2331	32.3287	32.4230	32.8732	32.9589	33.3634	33.3634	33.4394	33.2064	32.9589	32.7861	32.6074	
alpha	3.1489	3.1552	3.1615	3.1915	3.1973	3.2242	3.2242	3.2293	3.2138	3.1973	3.1857	3.1738	
util living area	0.9920	0.9866	0.9731	0.9377	0.8637	0.7370	0.5991	0.6570	0.8553	0.9621	0.9877	0.9934	(86)
MIT	18.8077	19.0183	19.4097	19.9446	20.4270	20.7735	20.9168	20.8861	20.5945	19.9612	19.2960	18.7788	(87)
Th 2	19.9522	19.9549	19.9577	19.9704	19.9728	19.9840	19.9840	19.9861	19.9797	19.9728	19.9680	19.9629	(88)
util rest of house	0.9904	0.9839	0.9673	0.9231	0.8290	0.6651	0.4873	0.5489	0.8046	0.9506	0.9847	0.9921	(89)
MIT 2	17.9380	18.1495	18.5397	19.0735	19.5329	19.8450	19.9489	19.9338	19.7007	19.0986	18.4365	17.9169	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0574	18.2688	18.6591	19.1930	19.6556	19.9724	20.0817	20.0645	19.8234	19.2170	18.5545	18.0352	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0574	18.2688	18.6591	19.1930	19.6556	19.9724	20.0817	20.0645	19.8234	19.2170	18.5545	18.0352	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9777	0.9576	0.9093	0.8163	0.6642	0.4990	0.5582	0.7952	0.9392	0.9789	0.9885	(94)
Useful gains	485.4502	558.0832	635.5718	699.2275	685.7292	552.3528	394.8974	403.4795	508.6267	508.5514	468.5087	459.3537	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1730.1418	1676.3006	1520.1891	1269.2599	978.4793	652.7561	423.0317	444.2278	698.6852	1059.8205	1416.2328	1719.9643	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	926.0505	751.4421	658.1552	410.4234	217.8060	0.0000	0.0000	0.0000	0.0000	410.1442	682.3614	937.8943	(98)
Space heating												4994.2771	(98)
Space heating per m2											(98) / (4) =	46.0642	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1142.1064	899.1051	921.3062	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7425	0.8133	0.7772	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	847.9643	731.2796	716.0804	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.9295	224.6316	178.0730	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												571.6341	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.2324	56.1579	44.5182	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.9085	(107)
Space cooling per m2												1.3181	(108)
Energy for space heating												46.0642	(99)
Energy for space cooling												1.3181	(108)
Total												47.3823	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.8600	
Infiltration rate		0.3497	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3396	0.3154	0.3235	0.3073	0.3073	0.2992	0.2911	0.2830	0.2750	0.2992	0.2830	0.2992	(22b)
Effective ac	0.5577	0.5497	0.5523	0.5472	0.5472	0.5448	0.5424	0.5401	0.5378	0.5448	0.5401	0.5448	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.7438	51.0066	51.2463	50.7730	50.7730	50.5455	50.3240	50.1086	49.8992	50.5455	50.1086	50.5455	(38)
Heat transfer coeff	121.5351	120.7978	121.0375	120.5642	120.5642	120.3367	120.1152	119.8998	119.6905	120.3367	119.8998	120.3367	(39)
Average = Sum(39)m / 12 =												120.4262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1142	1.1164	1.1120	1.1120	1.1099	1.1079	1.1059	1.1040	1.1099	1.1059	1.1099	(40)
HLP (average)												1.1107	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8637	34.0704	34.0029	34.1364	34.1364	34.2009	34.2640	34.3256	34.3856	34.2009	34.3256	34.2009	
alpha	3.2576	3.2714	3.2669	3.2758	3.2758	3.2801	3.2843	3.2884	3.2924	3.2801	3.2884	3.2801	
util living area	0.9705	0.9606	0.9316	0.8650	0.7508	0.5700	0.4333	0.4558	0.6998	0.8860	0.9533	0.9738	(86)
MIT	19.3516	19.5065	19.8678	20.3238	20.6937	20.9119	20.9732	20.9691	20.8208	20.3817	19.8198	19.3409	(87)
Th 2	19.9837	19.9893	19.9875	19.9910	19.9910	19.9927	19.9944	19.9960	19.9976	19.9927	19.9960	19.9927	(88)
util rest of house	0.9649	0.9532	0.9183	0.8379	0.6991	0.4873	0.3294	0.3479	0.6248	0.8563	0.9428	0.9688	(89)
MIT 2	17.8071	18.0334	18.5492	19.1880	19.6755	19.9258	19.9815	19.9809	19.8416	19.2825	18.4930	17.7979	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0190	18.2356	18.7302	19.3439	19.8153	20.0611	20.1176	20.1165	19.9760	19.4333	18.6751	18.0097	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8690	18.0856	18.5802	19.1939	19.6653	19.9111	19.9676	19.9665	19.8260	19.2833	18.5251	17.8597	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9339	0.8940	0.8120	0.6802	0.4801	0.3265	0.3446	0.6103	0.8299	0.9216	0.9532	(94)
Useful gains	728.6788	779.2754	829.1272	836.4426	725.1648	523.4096	338.2049	336.4206	543.3485	657.9924	684.0259	695.5370	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1576.1941	1544.4754	1401.6405	1168.7320	863.8737	554.8897	344.4412	343.6943	613.5361	948.6518	1273.9475	1547.4901 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	630.5514	514.2144	425.9499	239.2484	103.1994	0.0000	0.0000	0.0000	0.0000	216.2506	424.7435	633.8531 (98)
Space heating												3188.0108 (98)
RHI space heating demand												3188 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.8600	
Infiltration rate				0.3497	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4124	0.4043	0.3963	0.3558	0.3477	0.3073	0.3073	0.2992	0.3235	0.3477	0.3639	0.3801	(22b)
Effective ac	0.5850	0.5817	0.5785	0.5633	0.5605	0.5472	0.5472	0.5448	0.5523	0.5605	0.5662	0.5722	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2832	53.9768	53.6764	52.2657	52.0017	50.7730	50.7730	50.5455	51.2463	52.0017	52.5357	53.0939	(38)
Heat transfer coeff	124.0744	123.7680	123.4677	122.0569	121.7930	120.5642	120.5642	120.3367	121.0375	121.7930	122.3269	122.8852	(39)
Average = Sum(39)m / 12 =												122.0556	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1416	1.1388	1.1258	1.1233	1.1120	1.1120	1.1099	1.1164	1.1233	1.1283	1.1334	(40)
HLP (average)												1.1258	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1706	33.2528	33.3336	33.7189	33.7920	34.1364	34.1364	34.2009	34.0029	33.7920	33.6445	33.4917	
alpha	3.2114	3.2169	3.2222	3.2479	3.2528	3.2758	3.2758	3.2801	3.2669	3.2528	3.2430	3.2328	
util living area	0.9757	0.9654	0.9426	0.8902	0.7951	0.6497	0.5076	0.5544	0.7636	0.9148	0.9644	0.9788	(86)
MIT	19.1807	19.3738	19.7248	20.1891	20.5881	20.8530	20.9514	20.9345	20.7355	20.2204	19.6243	19.1445	(87)
Th 2	19.9647	19.9670	19.9693	19.9798	19.9818	19.9910	19.9910	19.9927	19.9875	19.9818	19.9778	19.9736	(88)
util rest of house	0.9712	0.9589	0.9313	0.8677	0.7516	0.5746	0.4049	0.4516	0.6995	0.8926	0.9566	0.9748	(89)
MIT 2	17.5478	17.8282	18.3339	18.9960	19.5352	19.8655	19.9628	19.9517	19.7373	19.0537	18.2006	17.5009	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7719	18.0403	18.5248	19.1597	19.6797	20.0010	20.0985	20.0866	19.8743	19.2138	18.3960	17.7265	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6219	17.8903	18.3748	19.0097	19.5297	19.8510	19.9485	19.9366	19.7243	19.0638	18.2460	17.5765	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9080	0.8412	0.7292	0.5632	0.4003	0.4455	0.6801	0.8664	0.9377	0.9610	(94)
Useful gains	711.9968	770.6277	817.6888	832.0100	761.1314	575.4438	390.2281	406.2013	570.9728	656.9852	668.6377	683.9151	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1652.9064	1607.7826	1466.1556	1233.9609	953.6002	633.0834	403.7089	425.5841	680.7457	1030.8303	1363.4553	1643.7676	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	700.0368	562.5681	482.4593	289.4046	143.1967	0.0000	0.0000	0.0000	0.0000	278.1407	500.2687	714.1303	(98)
Space heating												3670.2052	(98)
Space heating per m2											(98) / (4) =	33.8517	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4055.4754	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	700.0368	562.5681	482.4593	289.4046	143.1967	0.0000	0.0000	0.0000	0.0000	278.1407	500.2687	714.1303	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	773.5213	621.6222	533.1042	319.7841	158.2285	0.0000	0.0000	0.0000	0.0000	307.3378	552.7831	789.0942	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8290	89.7816	89.6696	89.4133	88.8965	87.3000	87.3000	87.3000	87.3000	89.3575	89.7000	89.8548	(217)
Fuel for water heating, kWh/month													
	199.4599	174.9942	181.8812	160.5428	156.0657	138.8278	130.3257	147.1641	148.2179	166.7283	179.3394	193.6100	(219)
Water heating fuel used												1977.1570	(219)
Annual totals kWh/year													
Space heating fuel - main system												4055.4754	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5298.0570	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4055.4754	3.4800	141.1305	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.1570	3.4800	68.8051	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			233.0451	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6380	(257)
SAP value		91.1002	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4055.4754	0.2160	875.9827	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.1570	0.2160	427.0659	(264)
Space and water heating			1303.0486	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			921.8040	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	8.5000 (273)
EI value	91.9488
EI rating	92 (274)
EI band	A

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.8600	
Infiltration rate			0.3497	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3396	0.3154	0.3235	0.3073	0.3073	0.2992	0.2911	0.2830	0.2750	0.2992	0.2830	0.2992	(22b)
Effective ac	0.5577	0.5497	0.5523	0.5472	0.5472	0.5448	0.5424	0.5401	0.5378	0.5448	0.5401	0.5448	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.7438	51.0066	51.2463	50.7730	50.7730	50.5455	50.3240	50.1086	49.8992	50.5455	50.1086	50.5455	(38)
Heat transfer coeff	121.5351	120.7978	121.0375	120.5642	120.5642	120.3367	120.1152	119.8998	119.6905	120.3367	119.8998	120.3367	(39)
Average = Sum(39)m / 12 =												120.4262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1142	1.1164	1.1120	1.1120	1.1099	1.1079	1.1059	1.1040	1.1099	1.1059	1.1099	(40)
HLP (average)												1.1107	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8637	34.0704	34.0029	34.1364	34.1364	34.2009	34.2640	34.3256	34.3856	34.2009	34.3256	34.2009	
alpha	3.2576	3.2714	3.2669	3.2758	3.2758	3.2801	3.2843	3.2884	3.2924	3.2801	3.2884	3.2801	
util living area	0.9705	0.9606	0.9316	0.8650	0.7508	0.5700	0.4333	0.4558	0.6998	0.8860	0.9533	0.9738	(86)
MIT	19.3516	19.5065	19.8678	20.3238	20.6937	20.9119	20.9732	20.9691	20.8208	20.3817	19.8198	19.3409	(87)
Th 2	19.9837	19.9893	19.9875	19.9910	19.9910	19.9927	19.9944	19.9960	19.9976	19.9927	19.9960	19.9927	(88)
util rest of house	0.9649	0.9532	0.9183	0.8379	0.6991	0.4873	0.3294	0.3479	0.6248	0.8563	0.9428	0.9688	(89)
MIT 2	17.8071	18.0334	18.5492	19.1880	19.6755	19.9258	19.9815	19.9809	19.8416	19.2825	18.4930	17.7979	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0190	18.2356	18.7302	19.3439	19.8153	20.0611	20.1176	20.1165	19.9760	19.4333	18.6751	18.0097	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8690	18.0856	18.5802	19.1939	19.6653	19.9111	19.9676	19.9665	19.8260	19.2833	18.5251	17.8597	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9339	0.8940	0.8120	0.6802	0.4801	0.3265	0.3446	0.6103	0.8299	0.9216	0.9532	(94)
Useful gains	728.6788	779.2754	829.1272	836.4426	725.1648	523.4096	338.2049	336.4206	543.3485	657.9924	684.0259	695.5370	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1576.1941	1544.4754	1401.6405	1168.7320	863.8737	554.8897	344.4412	343.6943	613.5361	948.6518	1273.9475	1547.4901	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	630.5514	514.2144	425.9499	239.2484	103.1994	0.0000	0.0000	0.0000	0.0000	216.2506	424.7435	633.8531	(98)
Space heating												3188.0108	(98)
Space heating per m2											(98) / (4) =	29.4043	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3522.6639	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	630.5514	514.2144	425.9499	239.2484	103.1994	0.0000	0.0000	0.0000	0.0000	216.2506	424.7435	633.8531	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	696.7419	568.1927	470.6629	264.3629	114.0325	0.0000	0.0000	0.0000	0.0000	238.9509	469.3299	700.3902	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7719	89.7302	89.5907	89.2729	88.6369	87.3000	87.3000	87.3000	87.3000	89.1668	89.5978	89.7912	(217)
Fuel for water heating, kWh/month	199.5868	175.0943	182.0413	160.7954	156.5228	138.8278	130.3257	147.1641	148.2179	167.0850	179.5439	193.7471	(219)
Water heating fuel used												1978.9521	(219)
Annual totals kWh/year													
Space heating fuel - main system												3522.6639	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4614.7469	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3522.6639	9.7400	343.1075	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1978.9521	9.7400	192.7499	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			313.0461	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3522.6639	0.2160	760.8954	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9521	0.2160	427.4537	(264)
Space and water heating			1188.3491	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			728.0640	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3522.6639	1.2200	4297.6499	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.9521	1.2200	2414.3216	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6711.9715 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	3.0700	-4391.4840 (269)
Primary energy kWh/year			3989.2835 (272)
Primary energy kWh/m2/year			36.7947 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (26.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	1.80 kg/m²	A 92	A 94
Total Savings	£81	1.80 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 512 TEST (15 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£200	£219	-£18
Mains gas	£640	£540	£100
Space heating	£475	£475	£0
Water heating	£193	£111	£81
Lighting	£173	£173	£0
Generated (PV)	-£527	-£527	£0
Total cost of fuels	£313	£232	£82
Total cost of uses	£314	£232	£81
Delivered energy	43 kWh/m²	34 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	37 kWh/m²	27 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.8600	
Infiltration rate		0.3497	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4124	0.4043	0.3963	0.3558	0.3477	0.3073	0.3073	0.2992	0.3235	0.3477	0.3639	0.3801	(22b)
Effective ac	0.5850	0.5817	0.5785	0.5633	0.5605	0.5472	0.5472	0.5448	0.5523	0.5605	0.5662	0.5722	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2832	53.9768	53.6764	52.2657	52.0017	50.7730	50.7730	50.5455	51.2463	52.0017	52.5357	53.0939	(38)
Heat transfer coeff	124.0744	123.7680	123.4677	122.0569	121.7930	120.5642	120.5642	120.3367	121.0375	121.7930	122.3269	122.8852	(39)
Average = Sum(39)m / 12 =												122.0556	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1416	1.1388	1.1258	1.1233	1.1120	1.1120	1.1099	1.1164	1.1233	1.1283	1.1334	(40)
HLP (average)												1.1258	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1706	33.2528	33.3336	33.7189	33.7920	34.1364	34.1364	34.2009	34.0029	33.7920	33.6445	33.4917	
alpha	3.2114	3.2169	3.2222	3.2479	3.2528	3.2758	3.2758	3.2801	3.2669	3.2528	3.2430	3.2328	
util living area	0.9757	0.9654	0.9426	0.8902	0.7951	0.6497	0.5076	0.5544	0.7636	0.9148	0.9644	0.9788	(86)
MIT	19.1807	19.3738	19.7248	20.1891	20.5881	20.8530	20.9514	20.9345	20.7355	20.2204	19.6243	19.1445	(87)
Th 2	19.9647	19.9670	19.9693	19.9798	19.9818	19.9910	19.9910	19.9927	19.9875	19.9818	19.9778	19.9736	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9712	0.9589	0.9313	0.8677	0.7516	0.5746	0.4049	0.4516	0.6995	0.8926	0.9566	0.9748	(89)
MIT 2	17.5478	17.8282	18.3339	18.9960	19.5352	19.8655	19.9628	19.9517	19.7373	19.0537	18.2006	17.5009	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7719	18.0403	18.5248	19.1597	19.6797	20.0010	20.0985	20.0866	19.8743	19.2138	18.3960	17.7265	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6219	17.8903	18.3748	19.0097	19.5297	19.8510	19.9485	19.9366	19.7243	19.0638	18.2460	17.5765	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9404	0.9080	0.8412	0.7292	0.5632	0.4003	0.4455	0.6801	0.8664	0.9377	0.9610	(94)
Useful gains	711.9968	770.6277	817.6888	832.0100	761.1314	575.4438	390.2281	406.2013	570.9728	656.9852	668.6377	683.9151	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1652.9064	1607.7826	1466.1556	1233.9609	953.6002	633.0834	403.7089	425.5841	680.7457	1030.8303	1363.4553	1643.7676	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	700.0368	562.5681	482.4593	289.4046	143.1967	0.0000	0.0000	0.0000	0.0000	278.1407	500.2687	714.1303	(98)
Space heating												3670.2052	(98)
Space heating per m2											(98) / (4) =	33.8517	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4055.4754	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	700.0368	562.5681	482.4593	289.4046	143.1967	0.0000	0.0000	0.0000	0.0000	278.1407	500.2687	714.1303	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	773.5213	621.6222	533.1042	319.7841	158.2285	0.0000	0.0000	0.0000	0.0000	307.3378	552.7831	789.0942	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9064	89.9413	89.9766	90.0394	90.1062	87.3000	87.3000	87.3000	87.3000	89.6640	89.8177	89.9192	(217)
Fuel for water heating, kWh/month													
	171.0765	127.6245	101.1453	52.1311	21.5143	4.4162	0.0000	31.2800	57.4574	105.8137	145.6082	169.8662	(219)
Water heating fuel used												987.9334	(219)
Annual totals kWh/year													
Space heating fuel - main system												4055.4754	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4358.8334	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4055.4754	3.4800	141.1305	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9334	3.4800	34.3801	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			205.2151	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5618	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	92.1630	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4055.4754	0.2160	875.9827	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9334	0.2160	213.3936	(264)
Space and water heating			1089.3763	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			734.0817	(272)
CO2 emissions per m2			6.7700	(273)
EI value			93.5884	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.8600	
Infiltration rate				0.3497	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3235	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3396	0.3154	0.3235	0.3073	0.3073	0.2992	0.2911	0.2830	0.2750	0.2992	0.2830	0.2992	(22b)
Effective ac	0.5577	0.5497	0.5523	0.5472	0.5472	0.5448	0.5424	0.5401	0.5378	0.5448	0.5401	0.5448	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.7438	51.0066	51.2463	50.7730	50.7730	50.5455	50.3240	50.1086	49.8992	50.5455	50.1086	50.5455	(38)
Heat transfer coeff	121.5351	120.7978	121.0375	120.5642	120.5642	120.3367	120.1152	119.8998	119.6905	120.3367	119.8998	120.3367	(39)
Average = Sum(39)m / 12 =												120.4262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1142	1.1164	1.1120	1.1120	1.1099	1.1079	1.1059	1.1040	1.1099	1.1059	1.1099	(40)
HLP (average)												1.1107	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8637	34.0704	34.0029	34.1364	34.1364	34.2009	34.2640	34.3256	34.3856	34.2009	34.3256	34.2009	
alpha	3.2576	3.2714	3.2669	3.2758	3.2758	3.2801	3.2843	3.2884	3.2924	3.2801	3.2884	3.2801	
util living area	0.9705	0.9606	0.9316	0.8650	0.7508	0.5700	0.4333	0.4558	0.6998	0.8860	0.9533	0.9738	(86)
MIT	19.3516	19.5065	19.8678	20.3238	20.6937	20.9119	20.9732	20.9691	20.8208	20.3817	19.8198	19.3409	(87)
Th 2	19.9837	19.9893	19.9875	19.9910	19.9910	19.9927	19.9944	19.9960	19.9976	19.9927	19.9960	19.9927	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9649	0.9532	0.9183	0.8379	0.6991	0.4873	0.3294	0.3479	0.6248	0.8563	0.9428	0.9688	(89)
MIT 2	17.8071	18.0334	18.5492	19.1880	19.6755	19.9258	19.9815	19.9809	19.8416	19.2825	18.4930	17.7979	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0190	18.2356	18.7302	19.3439	19.8153	20.0611	20.1176	20.1165	19.9760	19.4333	18.6751	18.0097	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8690	18.0856	18.5802	19.1939	19.6653	19.9111	19.9676	19.9665	19.8260	19.2833	18.5251	17.8597	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9339	0.8940	0.8120	0.6802	0.4801	0.3265	0.3446	0.6103	0.8299	0.9216	0.9532	(94)
Useful gains	728.6788	779.2754	829.1272	836.4426	725.1648	523.4096	338.2049	336.4206	543.3485	657.9924	684.0259	695.5370	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1576.1941	1544.4754	1401.6405	1168.7320	863.8737	554.8897	344.4412	343.6943	613.5361	948.6518	1273.9475	1547.4901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	630.5514	514.2144	425.9499	239.2484	103.1994	0.0000	0.0000	0.0000	0.0000	216.2506	424.7435	633.8531	(98)
Space heating												3188.0108	(98)
Space heating per m2											(98) / (4) =	29.4043	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3522.6639 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	630.5514	514.2144	425.9499	239.2484	103.1994	0.0000	0.0000	0.0000	0.0000	216.2506	424.7435	633.8531	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	696.7419	568.1927	470.6629	264.3629	114.0325	0.0000	0.0000	0.0000	0.0000	238.9509	469.3299	700.3902	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8688	89.8983	89.9224	89.9721	89.8849	87.3000	87.3000	87.3000	87.3000	89.5303	89.7486	89.8712	(217)
Fuel for water heating, kWh/month													
	166.3179	127.7822	100.6358	50.6770	26.3526	0.0000	0.0000	23.8211	51.6488	101.3052	140.0961	166.3957	(219)
Water heating fuel used												955.0322	(219)
Annual totals kWh/year													
Space heating fuel - main system												3522.6639	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												3640.8270	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3522.6639	9.7400	343.1075	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.0322	9.7400	93.0201	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			231.7413	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3522.6639	0.2160	760.8954	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.0322	0.2160	206.2869	(264)
Space and water heating			967.1823	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			532.8473	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3522.6639	1.2200	4297.6499	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.0322	1.2200	1165.1392	(264)
Space and water heating			5462.7892	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			2893.6011	(272)
Primary energy kWh/m2/year			26.6888	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-312	**Issued on Date**	15/03/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-Opp-SEMI
Property	19, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	91 B	**DER**	9.63	**TER**	17.43
Environmental	92 A	**% DER<TER**	44.75		
CO_2 Emissions (t/year)	0.70	**DFEE**	45.84	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.11		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.63 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.70 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.3417	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5780	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.9263	53.6337	53.3469	52.0000	51.7480	50.5748	50.5748	50.3576	51.0267	51.7480	52.2578	52.7908	(38)
Heat transfer coeff	123.7175	123.4249	123.1382	121.7912	121.5392	120.3661	120.3661	120.1488	120.8180	121.5392	122.0490	122.5820	(39)
Average = Sum(39)m / 12 =												121.7900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1411	1.1384	1.1358	1.1233	1.1210	1.1102	1.1102	1.1082	1.1144	1.1210	1.1257	1.1306	(40)
HLP (average)												1.1233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2663	33.3452	33.4228	33.7925	33.8625	34.1926	34.1926	34.2544	34.0647	33.8625	33.7211	33.5745	
alpha	3.2178	3.2230	3.2282	3.2528	3.2575	3.2795	3.2795	3.2836	3.2710	3.2575	3.2481	3.2383	
util living area	0.9891	0.9812	0.9637	0.9226	0.8427	0.7111	0.5686	0.6172	0.8188	0.9470	0.9826	0.9910	(86)
MIT	18.9509	19.1770	19.5603	20.0575	20.4974	20.8065	20.9324	20.9102	20.6665	20.0813	19.4257	18.9118	(87)
Th 2	19.9674	19.9696	19.9717	19.9818	19.9837	19.9925	19.9925	19.9942	19.9891	19.9837	19.9799	19.9759	(88)
util rest of house	0.9870	0.9774	0.9561	0.9052	0.8049	0.6376	0.4595	0.5103	0.7615	0.9317	0.9785	0.9892	(89)
MIT 2	17.2171	17.5470	18.1031	18.8192	19.4256	19.8217	19.9518	19.9357	19.6624	18.8655	17.9175	17.1651	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4550	17.7707	18.3031	18.9892	19.5727	19.9569	20.0864	20.0694	19.8002	19.0323	18.1245	17.4048	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3050	17.6207	18.1531	18.8392	19.4227	19.8069	19.9364	19.9194	19.6502	18.8823	17.9745	17.2548	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9645	0.9370	0.8798	0.7796	0.6223	0.4529	0.5015	0.7382	0.9086	0.9660	0.9816	(94)
Useful gains	546.0447	630.4188	703.4106	744.6926	704.1215	550.1229	382.3813	395.6648	531.1582	565.2294	529.3773	516.2193	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1608.9503	1570.0516	1434.9409	1210.5061	938.6150	626.7348	401.5848	422.8539	670.5673	1006.6263	1327.2215	1600.2894	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	790.8017	631.4332	544.2585	335.3857	174.4631	0.0000	0.0000	0.0000	0.0000	328.3993	574.4479	806.5482	(98)
Space heating												4185.7378	(98)
Space heating per m2											(98) / (4) =	38.6067	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4625.1246	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	790.8017	631.4332	544.2585	335.3857	174.4631	0.0000	0.0000	0.0000	0.0000	328.3993	574.4479	806.5482	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	873.8141	697.7163	601.3907	370.5920	192.7769	0.0000	0.0000	0.0000	0.0000	362.8722	634.7490	891.2134	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8914	89.8438	89.7415	89.5165	89.0540	87.3000	87.3000	87.3000	87.3000	89.4764	89.7800	89.9152	(217)
Fuel for water heating, kWh/month	199.3215	174.8729	181.7354	160.3577	155.7896	138.8278	130.3257	147.1641	148.2179	166.5067	179.1795	193.4799	(219)
Water heating fuel used												1975.7788	(219)
Annual totals kWh/year													
Space heating fuel - main system												4625.1246	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5866.3280	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4625.1246	0.2160	999.0269	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7788	0.2160	426.7682	(264)
Space and water heating			1425.7951	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1044.5505	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.6300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.6300	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		26.0655	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.0655	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
								Total per year (kWh/year) = Sum(64)m =				2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.3773	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3490	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4449	0.4362	0.4275	0.3839	0.3751	0.3315	0.3315	0.3228	0.3490	0.3751	0.3926	0.4100	(22b)
Effective ac	0.5990	0.5951	0.5914	0.5737	0.5704	0.5550	0.5550	0.5521	0.5609	0.5704	0.5771	0.5841	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.5763	55.2197	54.8701	53.2282	52.9210	51.4909	51.4909	51.2261	52.0417	52.9210	53.5424	54.1921	(38)
Heat transfer coeff	125.3676	125.0109	124.6613	123.0194	122.7122	121.2821	121.2821	121.0173	121.8330	122.7122	123.3337	123.9834	(39)
Average = Sum(39)m / 12 =												123.0179	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1563	1.1530	1.1498	1.1347	1.1318	1.1186	1.1186	1.1162	1.1237	1.1318	1.1376	1.1435	(40)
HLP (average)												1.1346	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3343	32.4266	32.5175	32.9515	33.0340	33.4235	33.4235	33.4967	33.2724	33.0340	32.8676	32.6953	
alpha	3.1556	3.1618	3.1678	3.1968	3.2023	3.2282	3.2282	3.2331	3.2182	3.2023	3.1912	3.1797	
util living area	0.9905	0.9832	0.9668	0.9279	0.8518	0.7238	0.5827	0.6331	0.8310	0.9522	0.9848	0.9922	(86)
MIT	18.8559	19.0879	19.4824	19.9992	20.4574	20.7867	20.9236	20.8984	20.6355	20.0238	19.3484	18.8212	(87)
Th 2	19.9551	19.9578	19.9604	19.9726	19.9749	19.9856	19.9856	19.9876	19.9815	19.9749	19.9703	19.9654	(88)
util rest of house	0.9886	0.9798	0.9599	0.9116	0.8153	0.6510	0.4722	0.5255	0.7758	0.9383	0.9812	0.9906	(89)
MIT 2	17.9880	18.2204	18.6126	19.1267	19.5610	19.8558	19.9537	19.9417	19.7350	19.1599	18.4900	17.9608	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.1071	18.3394	18.7320	19.2465	19.6840	19.9835	20.0868	20.0730	19.8586	19.2784	18.6078	18.0789	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1071	18.3394	18.7320	19.2465	19.6840	19.9835	20.0868	20.0730	19.8586	19.2784	18.6078	18.0789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8972	0.8031	0.6509	0.4841	0.5355	0.7679	0.9258	0.9745	0.9866	(94)
Useful gains	515.3478	603.0087	682.1254	732.9714	702.8850	558.6586	397.2138	408.4711	531.7315	548.5806	502.4614	485.6847	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1730.9684	1680.0739	1524.8590	1272.8169	979.7359	652.9250	422.8899	444.5013	701.5882	1064.9487	1419.2988	1720.7563	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	904.4217	723.7878	626.9938	388.6888	205.9771	0.0000	0.0000	0.0000	0.0000	384.1778	660.1229	918.8932	(98)
Space heating												4813.0632	(98)
Space heating per m2											(98) / (4) =	44.3928	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1140.0522	897.4879	919.7316	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7545	0.8249	0.7954	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	860.2150	740.3532	731.5698	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	182.6108	243.2424	201.2780	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												627.1311	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.6527	60.8106	50.3195	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.7828	(107)
Space cooling per m2												1.4461	(108)
Energy for space heating												44.3928	(99)
Energy for space cooling												1.4461	(108)
Total												45.8388	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)	
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)	
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)	
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.3417	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3319	0.3082	0.3161	0.3003	0.3003	0.2924	0.2845	0.2766	0.2687	0.2924	0.2766	0.2924	(22b)
Effective ac	0.5551	0.5475	0.5500	0.5451	0.5451	0.5427	0.5405	0.5382	0.5361	0.5427	0.5382	0.5427	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5018	50.7979	51.0267	50.5748	50.5748	50.3576	50.1461	49.9405	49.7406	50.3576	49.9405	50.3576	(38)
Heat transfer coeff	121.2930	120.5891	120.8180	120.3661	120.3661	120.1488	119.9374	119.7317	119.5319	120.1488	119.7317	120.1488	(39)
Average = Sum(39)m / 12 =												120.2343	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1187	1.1122	1.1144	1.1102	1.1102	1.1082	1.1062	1.1043	1.1025	1.1082	1.1043	1.1082	(40)
HLP (average)												1.1090	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9313	34.1293	34.0647	34.1926	34.1926	34.2544	34.3148	34.3737	34.4312	34.2544	34.3737	34.2544	
alpha	3.2621	3.2753	3.2710	3.2795	3.2795	3.2836	3.2877	3.2916	3.2954	3.2836	3.2916	3.2836	
util living area	0.9664	0.9542	0.9215	0.8521	0.7389	0.5596	0.4229	0.4396	0.6740	0.8683	0.9458	0.9705	(86)
MIT	19.4014	19.5674	19.9273	20.3623	20.7098	20.9169	20.9752	20.9723	20.8409	20.4301	19.8717	19.3841	(87)
Th 2	19.9856	19.9908	19.9891	19.9925	19.9925	19.9942	19.9957	19.9973	19.9988	19.9942	19.9973	19.9942	(88)
util rest of house	0.9602	0.9458	0.9066	0.8235	0.6866	0.4776	0.3211	0.3348	0.5982	0.8357	0.9340	0.9649	(89)
MIT 2	17.8796	18.1210	18.6328	19.2393	19.6951	19.9313	19.9838	19.9838	19.8623	19.3459	18.5667	17.8607	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0884	18.3195	18.8105	19.3934	19.8344	20.0666	20.1199	20.1195	19.9966	19.4947	18.7458	18.0698	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9384	18.1695	18.6605	19.2434	19.6844	19.9166	19.9699	19.9695	19.8466	19.3447	18.5958	17.9198	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7981	0.6685	0.4708	0.3183	0.3318	0.5854	0.8097	0.9116	0.9483	(94)
Useful gains	759.7933	817.8077	865.7900	858.9990	733.3830	525.0439	338.4497	337.1009	553.1818	686.6171	716.7351	722.8246	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1581.4705	1551.9223	1408.7935	1172.7797	864.7581	554.6735	344.2057	343.5711	615.1835	954.5451	1280.6259	1552.3015 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	611.3279	493.3251	403.9946	225.9222	97.7431	0.0000	0.0000	0.0000	0.0000	199.3385	406.0014	617.1308 (98)
Space heating												3054.7835 (98)
RHI space heating demand												3055 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.3417	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5780	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.9263	53.6337	53.3469	52.0000	51.7480	50.5748	50.5748	50.3576	51.0267	51.7480	52.2578	52.7908	(38)
Heat transfer coeff	123.7175	123.4249	123.1382	121.7912	121.5392	120.3661	120.3661	120.1488	120.8180	121.5392	122.0490	122.5820	(39)
Average = Sum(39)m / 12 =												121.7900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1411	1.1384	1.1358	1.1233	1.1210	1.1102	1.1102	1.1082	1.1144	1.1210	1.1257	1.1306	(40)
HLP (average)												1.1233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2663	33.3452	33.4228	33.7925	33.8625	34.1926	34.1926	34.2544	34.0647	33.8625	33.7211	33.5745	
alpha	3.2178	3.2230	3.2282	3.2528	3.2575	3.2795	3.2795	3.2836	3.2710	3.2575	3.2481	3.2383	
util living area	0.9728	0.9597	0.9335	0.8782	0.7826	0.6379	0.4947	0.5354	0.7391	0.9010	0.9594	0.9765	(86)
MIT	19.2257	19.4375	19.7888	20.2341	20.6107	20.8614	20.9552	20.9411	20.7626	20.2720	19.6719	19.1842	(87)
Th 2	19.9674	19.9696	19.9717	19.9818	19.9837	19.9925	19.9925	19.9942	19.9891	19.9837	19.9799	19.9759	(88)
util rest of house	0.9678	0.9523	0.9209	0.8541	0.7380	0.5629	0.3938	0.4346	0.6730	0.8763	0.9506	0.9721	(89)
MIT 2	17.6142	17.9206	18.4252	19.0574	19.5639	19.8748	19.9666	19.9577	19.7676	19.1238	18.2695	17.5596	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8354	18.1288	18.6124	19.2189	19.7076	20.0102	20.1023	20.0927	19.9042	19.2814	18.4620	17.7825	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6854	17.9788	18.4624	19.0689	19.5576	19.8602	19.9523	19.9427	19.7542	19.1314	18.3120	17.6325	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8965	0.8277	0.7165	0.5521	0.3895	0.4290	0.6554	0.8498	0.9305	0.9574	(94)
Useful gains	738.7938	809.9067	856.7083	858.3448	773.0444	578.9280	391.1134	408.3452	584.9244	687.7622	697.9097	707.7389	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.0079	1614.2453	1473.0263	1238.4828	955.0008	633.1518	403.5032	425.6459	683.1265	1036.8987	1368.4083	1646.5877	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	682.4073	540.5155	458.5406	273.6994	135.3756	0.0000	0.0000	0.0000	0.0000	259.7576	482.7590	698.5035	(98)
Space heating												3531.5585	(98)
Space heating per m2											(98) / (4) =	32.5729	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3902.2745	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	682.4073	540.5155	458.5406	273.6994	135.3756	0.0000	0.0000	0.0000	0.0000	259.7576	482.7590	698.5035	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	754.0412	597.2547	506.6747	302.4303	149.5862	0.0000	0.0000	0.0000	0.0000	287.0250	533.4353	771.8271	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8154	89.7590	89.6380	89.3730	88.8516	87.3000	87.3000	87.3000	87.3000	89.3068	89.6784	89.8433	(217)
Fuel for water heating, kWh/month	199.4902	175.0382	181.9454	160.6154	156.1446	138.8278	130.3257	147.1641	148.2179	166.8230	179.3825	193.6347	(219)
Water heating fuel used												1977.6094	(219)
Annual totals kWh/year													
Space heating fuel - main system												3902.2745	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5145.3085	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3902.2745	3.4800	135.7992	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.6094	3.4800	68.8208	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			227.7295	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6234	(257)
SAP value		91.3032	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3902.2745	0.2160	842.8913	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.6094	0.2160	427.1636	(264)
Space and water heating			1270.0549	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			888.8103	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	8.2000 (273)
EI value	92.2370
EI rating	92 (274)
EI band	A

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.7000	
Infiltration rate				0.3417	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3319	0.3082	0.3161	0.3003	0.3003	0.2924	0.2845	0.2766	0.2687	0.2924	0.2766	0.2924	(22b)
Effective ac	0.5551	0.5475	0.5500	0.5451	0.5451	0.5427	0.5405	0.5382	0.5361	0.5427	0.5382	0.5427	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss						(33) + (36) =	69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5018	50.7979	51.0267	50.5748	50.5748	50.3576	50.1461	49.9405	49.7406	50.3576	49.9405	50.3576	(38)
Heat transfer coeff	121.2930	120.5891	120.8180	120.3661	120.3661	120.1488	119.9374	119.7317	119.5319	120.1488	119.7317	120.1488	(39)
Average = Sum(39)m / 12 =												120.2343	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1187	1.1122	1.1144	1.1102	1.1102	1.1082	1.1062	1.1043	1.1025	1.1082	1.1043	1.1082	(40)
HLP (average)												1.1090	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9313	34.1293	34.0647	34.1926	34.1926	34.2544	34.3148	34.3737	34.4312	34.2544	34.3737	34.2544	
alpha	3.2621	3.2753	3.2710	3.2795	3.2795	3.2836	3.2877	3.2916	3.2954	3.2836	3.2916	3.2836	
util living area	0.9664	0.9542	0.9215	0.8521	0.7389	0.5596	0.4229	0.4396	0.6740	0.8683	0.9458	0.9705	(86)
MIT	19.4014	19.5674	19.9273	20.3623	20.7098	20.9169	20.9752	20.9723	20.8409	20.4301	19.8717	19.3841	(87)
Th 2	19.9856	19.9908	19.9891	19.9925	19.9925	19.9942	19.9957	19.9973	19.9988	19.9942	19.9973	19.9942	(88)
util rest of house	0.9602	0.9458	0.9066	0.8235	0.6866	0.4776	0.3211	0.3348	0.5982	0.8357	0.9340	0.9649	(89)
MIT 2	17.8796	18.1210	18.6328	19.2393	19.6951	19.9313	19.9838	19.9838	19.8623	19.3459	18.5667	17.8607	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0884	18.3195	18.8105	19.3934	19.8344	20.0666	20.1199	20.1195	19.9966	19.4947	18.7458	18.0698	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9384	18.1695	18.6605	19.2434	19.6844	19.9166	19.9699	19.9695	19.8466	19.3447	18.5958	17.9198	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7981	0.6685	0.4708	0.3183	0.3318	0.5854	0.8097	0.9116	0.9483	(94)
Useful gains	759.7933	817.8077	865.7900	858.9990	733.3830	525.0439	338.4497	337.1009	553.1818	686.6171	716.7351	722.8246	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1581.4705	1551.9223	1408.7935	1172.7797	864.7581	554.6735	344.2057	343.5711	615.1835	954.5451	1280.6259	1552.3015	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	611.3279	493.3251	403.9946	225.9222	97.7431	0.0000	0.0000	0.0000	0.0000	199.3385	406.0014	617.1308	(98)
Space heating												3054.7835	(98)
Space heating per m2											(98) / (4) =	28.1755	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3375.4513	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	611.3279	493.3251	403.9946	225.9222	97.7431	0.0000	0.0000	0.0000	0.0000	199.3385	406.0014	617.1308	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	675.5004	545.1106	446.4029	249.6377	108.0034	0.0000	0.0000	0.0000	0.0000	220.2635	448.6203	681.9125	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7543	89.7057	89.5559	89.2293	88.5948	87.3000	87.3000	87.3000	87.3000	89.1030	89.5683	89.7763	(217)
Fuel for water heating, kWh/month	199.6259	175.1421	182.1121	160.8740	156.5972	138.8278	130.3257	147.1641	148.2179	167.2045	179.6031	193.7792	(219)
Water heating fuel used												1979.4736	(219)
Annual totals kWh/year													
Space heating fuel - main system												3375.4513	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4468.0558	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3375.4513	9.7400	328.7690	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4736	9.7400	192.8007	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			298.7584	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3375.4513	0.2160	729.0975	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4736	0.2160	427.5663	(264)
Space and water heating			1156.6638	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			696.3787	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3375.4513	1.2200	4118.0506	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4736	1.2200	2414.9577	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			6533.0084 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	3.0700	-4391.4840 (269)
Primary energy kWh/year			3810.3203 (272)
Primary energy kWh/m2/year			35.1441 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (28.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	1.80 kg/m²	A 92	A 94
Total Savings	£81	1.80 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£200	£219	-£18
Mains gas	£626	£526	£100
Space heating	£460	£460	£0
Water heating	£193	£111	£81
Lighting	£173	£173	£0
Generated (PV)	-£527	-£527	£0
Total cost of fuels	£299	£218	£82
Total cost of uses	£299	£217	£81
Delivered energy	41 kWh/m²	32 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	5 kg/m²	2 kg/m²
Primary energy	35 kWh/m²	25 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.3417	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5780	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.9263	53.6337	53.3469	52.0000	51.7480	50.5748	50.5748	50.3576	51.0267	51.7480	52.2578	52.7908	(38)
Heat transfer coeff	123.7175	123.4249	123.1382	121.7912	121.5392	120.3661	120.3661	120.1488	120.8180	121.5392	122.0490	122.5820	(39)
Average = Sum(39)m / 12 =												121.7900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1411	1.1384	1.1358	1.1233	1.1210	1.1102	1.1102	1.1082	1.1144	1.1210	1.1257	1.1306	(40)
HLP (average)												1.1233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2663	33.3452	33.4228	33.7925	33.8625	34.1926	34.1926	34.2544	34.0647	33.8625	33.7211	33.5745	
alpha	3.2178	3.2230	3.2282	3.2528	3.2575	3.2795	3.2795	3.2836	3.2710	3.2575	3.2481	3.2383	
util living area	0.9728	0.9597	0.9335	0.8782	0.7826	0.6379	0.4947	0.5354	0.7391	0.9010	0.9594	0.9765	(86)
MIT	19.2257	19.4375	19.7888	20.2341	20.6107	20.8614	20.9552	20.9411	20.7626	20.2720	19.6719	19.1842	(87)
Th 2	19.9674	19.9696	19.9717	19.9818	19.9837	19.9925	19.9925	19.9942	19.9891	19.9837	19.9799	19.9759	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9523	0.9209	0.8541	0.7380	0.5629	0.3938	0.4346	0.6730	0.8763	0.9506	0.9721	(89)
MIT 2	17.6142	17.9206	18.4252	19.0574	19.5639	19.8748	19.9666	19.9577	19.7676	19.1238	18.2695	17.5596	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8354	18.1288	18.6124	19.2189	19.7076	20.0102	20.1023	20.0927	19.9042	19.2814	18.4620	17.7825	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6854	17.9788	18.4624	19.0689	19.5576	19.8602	19.9523	19.9427	19.7542	19.1314	18.3120	17.6325	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9324	0.8965	0.8277	0.7165	0.5521	0.3895	0.4290	0.6554	0.8498	0.9305	0.9574	(94)
Useful gains	738.7938	809.9067	856.7083	858.3448	773.0444	578.9280	391.1134	408.3452	584.9244	687.7622	697.9097	707.7389	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1656.0079	1614.2453	1473.0263	1238.4828	955.0008	633.1518	403.5032	425.6459	683.1265	1036.8987	1368.4083	1646.5877	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	682.4073	540.5155	458.5406	273.6994	135.3756	0.0000	0.0000	0.0000	0.0000	259.7576	482.7590	698.5035	(98)
Space heating												3531.5585	(98)
Space heating per m2											(98) / (4) =	32.5729	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3902.2745	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	682.4073	540.5155	458.5406	273.6994	135.3756	0.0000	0.0000	0.0000	0.0000	259.7576	482.7590	698.5035	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	754.0412	597.2547	506.6747	302.4303	149.5862	0.0000	0.0000	0.0000	0.0000	287.0250	533.4353	771.8271	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8939	89.9226	89.9540	90.0170	90.0864	87.3000	87.3000	87.3000	87.3000	89.6211	89.7984	89.9087	(217)
Fuel for water heating, kWh/month													
	171.1002	127.6510	101.1708	52.1441	21.5190	4.4162	0.0000	31.2800	57.4574	105.8644	145.6395	169.8862	(219)
Water heating fuel used												988.1288	(219)
Annual totals kWh/year													
Space heating fuel - main system												3902.2745	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4205.8280	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3902.2745	3.4800	135.7992	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.1288	3.4800	34.3869	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			199.8905	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5472	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	92.3663	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3902.2745	0.2160	842.8913	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.1288	0.2160	213.4358	(264)
Space and water heating			1056.3271	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			701.0325	(272)
CO2 emissions per m2			6.4700	(273)
EI value			93.8770	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.7000	
Infiltration rate				0.3417	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3161	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3319	0.3082	0.3161	0.3003	0.3003	0.2924	0.2845	0.2766	0.2687	0.2924	0.2766	0.2924	(22b)
Effective ac	0.5551	0.5475	0.5500	0.5451	0.5451	0.5427	0.5405	0.5382	0.5361	0.5427	0.5382	0.5427	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.5018	50.7979	51.0267	50.5748	50.5748	50.3576	50.1461	49.9405	49.7406	50.3576	49.9405	50.3576	(38)
Heat transfer coeff	121.2930	120.5891	120.8180	120.3661	120.3661	120.1488	119.9374	119.7317	119.5319	120.1488	119.7317	120.1488	(39)
Average = Sum(39)m / 12 =												120.2343	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1187	1.1122	1.1144	1.1102	1.1102	1.1082	1.1062	1.1043	1.1025	1.1082	1.1043	1.1082	(40)
HLP (average)												1.1090	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
								Total per year (kWh/year) = Sum(64)m =				855.9781	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9313	34.1293	34.0647	34.1926	34.1926	34.2544	34.3148	34.3737	34.4312	34.2544	34.3737	34.2544	
alpha	3.2621	3.2753	3.2710	3.2795	3.2795	3.2836	3.2877	3.2916	3.2954	3.2836	3.2916	3.2836	
util living area	0.9664	0.9542	0.9215	0.8521	0.7389	0.5596	0.4229	0.4396	0.6740	0.8683	0.9458	0.9705	(86)
MIT	19.4014	19.5674	19.9273	20.3623	20.7098	20.9169	20.9752	20.9723	20.8409	20.4301	19.8717	19.3841	(87)
Th 2	19.9856	19.9908	19.9891	19.9925	19.9925	19.9942	19.9957	19.9973	19.9988	19.9942	19.9973	19.9942	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9602	0.9458	0.9066	0.8235	0.6866	0.4776	0.3211	0.3348	0.5982	0.8357	0.9340	0.9649 (89)
MIT 2	17.8796	18.1210	18.6328	19.2393	19.6951	19.9313	19.9838	19.9838	19.8623	19.3459	18.5667	17.8607 (90)
Living area fraction										fLA = Living area / (4) =		0.1372 (91)
MIT	18.0884	18.3195	18.8105	19.3934	19.8344	20.0666	20.1199	20.1195	19.9966	19.4947	18.7458	18.0698 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9384	18.1695	18.6605	19.2434	19.6844	19.9166	19.9699	19.9695	19.8466	19.3447	18.5958	17.9198 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9423	0.9251	0.8816	0.7981	0.6685	0.4708	0.3183	0.3318	0.5854	0.8097	0.9116	0.9483	(94)
Useful gains	759.7933	817.8077	865.7900	858.9990	733.3830	525.0439	338.4497	337.1009	553.1818	686.6171	716.7351	722.8246	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1581.4705	1551.9223	1408.7935	1172.7797	864.7581	554.6735	344.2057	343.5711	615.1835	954.5451	1280.6259	1552.3015	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	611.3279	493.3251	403.9946	225.9222	97.7431	0.0000	0.0000	0.0000	0.0000	199.3385	406.0014	617.1308	(98)
Space heating												3054.7835	(98)
Space heating per m2											(98) / (4) =	28.1755	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3375.4513	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	611.3279	493.3251	403.9946	225.9222	97.7431	0.0000	0.0000	0.0000	0.0000	199.3385	406.0014	617.1308	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	675.5004	545.1106	446.4029	249.6377	108.0034	0.0000	0.0000	0.0000	0.0000	220.2635	448.6203	681.9125	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8529	89.8778	89.8970	89.9463	89.8575	87.3000	87.3000	87.3000	87.3000	89.4744	89.7223	89.8575	(217)
Fuel for water heating, kWh/month													
	166.3472	127.8113	100.6643	50.6915	26.3606	0.0000	0.0000	23.8211	51.6488	101.3685	140.1371	166.4209	(219)
Water heating fuel used												955.2712	(219)
Annual totals kWh/year													
Space heating fuel - main system												3375.4513	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												3493.8535	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3375.4513	9.7400	328.7690	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.2712	9.7400	93.0434	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			217.4261	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3375.4513	0.2160	729.0975 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.2712	0.2160	206.3386 (264)
Space and water heating			935.4361 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	468.5817	0.5190	243.1939 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	0.5190	-742.4040 (269)
Total kg/year			501.1010 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3375.4513	1.2200	4118.0506 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.2712	1.2200	1165.4309 (264)
Space and water heating			5283.4815 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	3.0700	-4391.4840 (269)
Primary energy kWh/year			2714.2935 (272)
Primary energy kWh/m2/year			25.0350 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14 (P1)
Transmission heat loss coefficient	69.79 (37)
Summer heat loss coefficient	440.93 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.49	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-313	**Issued on Date**	15/03/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-As-SEMI
Property	21, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.86	**TER**	17.77
Environmental	91 B	**% DER<TER**	38.89		
CO_2 Emissions (t/year)	0.83	**DFEE**	46.87	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.89		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.86 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.9 kWh/m²/yrOK
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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.42 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3277	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3215	53.0525	52.7887	51.5499	51.3181	50.2391	50.2391	50.0393	50.6547	51.3181	51.7870	52.2772	(38)
Heat transfer coeff	122.9336	122.6645	122.4008	121.1619	120.9301	119.8512	119.8512	119.6514	120.2668	120.9301	121.3990	121.8892	(39)
Average = Sum(39)m / 12 =												121.1608	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1339	1.1314	1.1289	1.1175	1.1154	1.1054	1.1054	1.1036	1.1093	1.1154	1.1197	1.1242	(40)
HLP (average)												1.1175	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4785	33.5519	33.6242	33.9680	34.0331	34.3395	34.3395	34.3968	34.2208	34.0331	33.9016	33.7653	
alpha	3.2319	3.2368	3.2416	3.2645	3.2689	3.2893	3.2893	3.2931	3.2814	3.2689	3.2601	3.2510	
util living area	0.9908	0.9849	0.9703	0.9323	0.8537	0.7225	0.5824	0.6385	0.8424	0.9572	0.9857	0.9923	(86)
MIT	18.9233	19.1274	19.5060	20.0166	20.4769	20.7982	20.9281	20.9013	20.6337	20.0304	19.3879	18.8875	(87)
Th 2	19.9733	19.9753	19.9773	19.9865	19.9883	19.9964	19.9964	19.9979	19.9933	19.9883	19.9848	19.9811	(88)
util rest of house	0.9890	0.9818	0.9639	0.9167	0.8176	0.6499	0.4725	0.5312	0.7893	0.9445	0.9823	0.9908	(89)
MIT 2	17.1804	17.4789	18.0293	18.7665	19.4038	19.8169	19.9526	19.9326	19.6281	18.7980	17.8660	17.1329	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4196	17.7051	18.2320	18.9381	19.5511	19.9516	20.0865	20.0656	19.7661	18.9672	18.0749	17.3737	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2696	17.5551	18.0820	18.7881	19.4011	19.8016	19.9365	19.9156	19.6161	18.8172	17.9249	17.2237	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9812	0.9706	0.9468	0.8922	0.7919	0.6338	0.4653	0.5214	0.7645	0.9232	0.9714	0.9840	(94)
Useful gains	516.7564	586.6725	658.5113	712.4139	687.4068	543.3686	379.3471	390.5386	509.7246	527.1996	496.3670	490.3661	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1594.3965	1552.3332	1417.6420	1198.0570	931.2940	623.4184	399.8823	420.6452	663.4075	993.7026	1314.1290	1587.4488	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	801.7643	648.9240	564.7932	349.6630	181.4521	0.0000	0.0000	0.0000	0.0000	347.0782	588.7886	816.2296	(98)
Space heating												4298.6930	(98)
Space heating per m2											(98) / (4) =	39.6485	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4749.9370	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	801.7643	648.9240	564.7932	349.6630	181.4521	0.0000	0.0000	0.0000	0.0000	347.0782	588.7886	816.2296	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	885.9274	717.0430	624.0809	386.3680	200.4996	0.0000	0.0000	0.0000	0.0000	383.5119	650.5952	901.9111	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8981	89.8580	89.7628	89.5447	89.0851	87.3000	87.3000	87.3000	87.3000	89.5146	89.7937	89.9209	(217)
Fuel for water heating, kWh/month													
	199.3065	174.8454	181.6924	160.3073	155.7353	138.8278	130.3257	147.1641	148.2179	166.4358	179.1522	193.4677	(219)
Water heating fuel used												1975.4781	(219)
Annual totals kWh/year													
Space heating fuel - main system												4749.9370	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												6194.0974	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4749.9370	0.2160	1025.9864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.4781	0.2160	426.7033	(264)
Space and water heating			1452.6897	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1176.9358	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.8600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.8600	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		27.2955	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.2955	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4859	(36)
Total fabric heat loss (33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5068.5340	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3633	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3360	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4284	0.4200	0.4116	0.3696	0.3612	0.3192	0.3192	0.3108	0.3360	0.3612	0.3780	0.3948	(22b)
Effective ac	0.5918	0.5882	0.5847	0.5683	0.5652	0.5510	0.5510	0.5483	0.5565	0.5652	0.5715	0.5779	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.9073	54.5767	54.2526	52.7302	52.4454	51.1195	51.1195	50.8740	51.6302	52.4454	53.0216	53.6240	(38)
Heat transfer coeff	124.5194	124.1887	123.8646	122.3423	122.0574	120.7315	120.7315	120.4860	121.2423	122.0574	122.6336	123.2360	(39)
Average = Sum(39)m / 12 =												122.3409	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1485	1.1454	1.1425	1.1284	1.1258	1.1136	1.1136	1.1113	1.1183	1.1258	1.1311	1.1367	(40)
HLP (average)												1.1284	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8050 (42)
Average daily hot water use (litres/day) 100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5546	32.6413	32.7267	33.1339	33.2112	33.5760	33.5760	33.6444	33.4345	33.2112	33.0552	32.8936	
alpha	3.1703	3.1761	3.1818	3.2089	3.2141	3.2384	3.2384	3.2430	3.2290	3.2141	3.2037	3.1929	
util living area	0.9921	0.9866	0.9730	0.9373	0.8626	0.7353	0.5968	0.6550	0.8542	0.9619	0.9876	0.9934	(86)
MIT	18.8288	19.0384	19.4277	19.9575	20.4362	20.7778	20.9188	20.8885	20.6005	19.9718	19.3106	18.7974	(87)
Th 2	19.9614	19.9639	19.9663	19.9777	19.9798	19.9898	19.9898	19.9916	19.9859	19.9798	19.9755	19.9710	(88)
util rest of house	0.9905	0.9839	0.9672	0.9227	0.8278	0.6635	0.4857	0.5474	0.8035	0.9504	0.9847	0.9921	(89)
MIT 2	17.9656	18.1759	18.5638	19.0915	19.5469	19.8534	19.9555	19.9404	19.7111	19.1141	18.4564	17.9411	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0841	18.2943	18.6823	19.2103	19.6690	19.9803	20.0877	20.0706	19.8332	19.2318	18.5737	18.0587	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0841	18.2943	18.6823	19.2103	19.6690	19.9803	20.0877	20.0706	19.8332	19.2318	18.5737	18.0587	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9778	0.9576	0.9089	0.8153	0.6627	0.4974	0.5567	0.7943	0.9391	0.9789	0.9885	(94)
Useful gains	485.4825	558.1066	635.5297	698.9425	684.8964	551.1363	393.6456	402.3968	508.0217	508.4742	468.5277	459.3808	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1716.3836	1663.4191	1508.9609	1261.3895	972.6718	649.5669	421.0751	442.2508	695.1006	1053.5806	1407.0583	1707.8855	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	915.7905	742.7700	649.8328	404.9619	214.1049	0.0000	0.0000	0.0000	0.0000	405.5592	675.7420	928.8875	(98)
Space heating												4937.6487	(98)
Space heating per m2											(98) / (4) =	45.5419	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1134.8765	893.4134	915.6937	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7457	0.8163	0.7803	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	846.3181	729.2942	714.4995	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.1148	226.1088	179.2492	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												575.4727	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.5287	56.5272	44.8123	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												143.8682	(107)
Space cooling per m2												1.3270	(108)
Energy for space heating												45.5419	(99)
Energy for space cooling												1.3270	(108)
Total												46.8688	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												332.3747	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												83.0937	(107)
Space cooling per m2												0.7664	(108)
Energy for space heating												47.6900	(99)
Energy for space cooling												0.7664	(108)
Total												48.4564	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		4.4200	
Infiltration rate		0.3277	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3183	0.2955	0.3031	0.2880	0.2880	0.2804	0.2728	0.2652	0.2577	0.2804	0.2652	0.2804	(22b)
Effective ac	0.5507	0.5437	0.5459	0.5415	0.5415	0.5393	0.5372	0.5352	0.5332	0.5393	0.5352	0.5393	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.0916	50.4443	50.6547	50.2391	50.2391	50.0393	49.8448	49.6557	49.4718	50.0393	49.6557	50.0393	(38)
Heat transfer coeff	120.7037	120.0563	120.2668	119.8512	119.8512	119.6514	119.4569	119.2677	119.0839	119.6514	119.2677	119.6514	(39)
Average = Sum(39)m / 12 =												119.7299	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1133	1.1073	1.1093	1.1054	1.1054	1.1036	1.1018	1.1001	1.0984	1.1036	1.1001	1.1036	(40)
HLP (average)												1.1043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0969	34.2808	34.2208	34.3395	34.3395	34.3968	34.4528	34.5075	34.5607	34.3968	34.5075	34.3968	
alpha	3.2731	3.2854	3.2814	3.2893	3.2893	3.2931	3.2969	3.3005	3.3040	3.2931	3.3005	3.2931	
util living area													
	0.9704	0.9605	0.9312	0.8641	0.7492	0.5679	0.4314	0.4539	0.6982	0.8853	0.9531	0.9738	(86)
MIT	19.3661	19.5193	19.8797	20.3325	20.6991	20.9140	20.9740	20.9699	20.8238	20.3888	19.8290	19.3529	(87)
Th 2	19.9900	19.9949	19.9933	19.9964	19.9964	19.9979	19.9994	20.0008	20.0022	19.9979	20.0008	19.9979	(88)
util rest of house													
	0.9648	0.9531	0.9178	0.8369	0.6976	0.4856	0.3283	0.3468	0.6234	0.8555	0.9426	0.9687	(89)
MIT 2	17.8319	18.0553	18.5699	19.2036	19.6864	19.9325	19.9868	19.9860	19.8488	19.2957	18.5091	17.8183	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0425	18.2563	18.7497	19.3585	19.8254	20.0672	20.1223	20.1210	19.9826	19.4457	18.6903	18.0289	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8925	18.1063	18.5997	19.2085	19.6754	19.9172	19.9723	19.9710	19.8326	19.2957	18.5403	17.8789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8937	0.8112	0.6789	0.4786	0.3254	0.3435	0.6091	0.8293	0.9215	0.9532	(94)
Useful gains	728.6361	779.1776	828.8184	835.6723	723.7588	521.7456	337.0522	335.3429	542.2415	657.5184	683.9166	695.5153	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	1568.2381	1537.4727	1395.0569	1163.5767	859.9754	552.4558	343.1113	342.4235	611.2116	944.7316	1269.0402	1540.9789	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.6639	509.5743	421.2814	236.0912	101.3451	0.0000	0.0000	0.0000	0.0000	213.6866	421.2890	629.0250	(98)
Space heating												3156.9565	(98)
RHI space heating demand												3157	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3277	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3215	53.0525	52.7887	51.5499	51.3181	50.2391	50.2391	50.0393	50.6547	51.3181	51.7870	52.2772	(38)
Heat transfer coeff	122.9336	122.6645	122.4008	121.1619	120.9301	119.8512	119.8512	119.6514	120.2668	120.9301	121.3990	121.8892	(39)
Average = Sum(39)m / 12 =												121.1608	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1339	1.1314	1.1289	1.1175	1.1154	1.1054	1.1054	1.1036	1.1093	1.1154	1.1197	1.1242	(40)
HLP (average)												1.1175	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4785	33.5519	33.6242	33.9680	34.0331	34.3395	34.3395	34.3968	34.2208	34.0331	33.9016	33.7653	
alpha	3.2319	3.2368	3.2416	3.2645	3.2689	3.2893	3.2893	3.2931	3.2814	3.2689	3.2601	3.2510	
util living area													
	0.9756	0.9652	0.9421	0.8893	0.7935	0.6477	0.5055	0.5524	0.7619	0.9141	0.9643	0.9788	(86)
MIT	19.2010	19.3930	19.7417	20.2008	20.5958	20.8561	20.9528	20.9361	20.7403	20.2303	19.6383	19.1623	(87)
Th 2	19.9733	19.9753	19.9773	19.9865	19.9883	19.9964	19.9964	19.9979	19.9933	19.9883	19.9848	19.9811	(88)
util rest of house													
	0.9711	0.9587	0.9309	0.8668	0.7500	0.5729	0.4034	0.4502	0.6979	0.8919	0.9564	0.9748	(89)
MIT 2	17.5823	17.8609	18.3632	19.0167	19.5500	19.8735	19.9689	19.9578	19.7476	19.0716	18.2251	17.5312	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.8045	18.0712	18.5523	19.1792	19.6935	20.0084	20.1039	20.0921	19.8838	19.2306	18.4191	17.7551	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6545	17.9212	18.4023	19.0292	19.5435	19.8584	19.9539	19.9421	19.7338	19.0806	18.2691	17.6051	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9403	0.9077	0.8405	0.7279	0.5616	0.3989	0.4441	0.6787	0.8659	0.9376	0.9610	(94)
Useful gains	711.9823	770.5362	817.3931	831.2987	759.7331	573.8556	388.8652	404.9185	569.8480	656.6017	668.5614	683.9170	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	1641.7150	1597.2372	1456.8564	1227.2763	948.5146	630.2198	401.9725	423.8175	677.5606	1025.5653	1355.9119	1633.9365 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	691.7211	555.5431	475.7607	285.1038	140.4534	0.0000	0.0000	0.0000	0.0000	274.5089	494.8924	706.8145 (98)
Space heating												3624.7979 (98)
Space heating per m2											(98) / (4) =	33.4329 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4005.3015	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	691.7211	555.5431	475.7607	285.1038	140.4534	0.0000	0.0000	0.0000	0.0000	274.5089	494.8924	706.8145	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	764.3327	613.8597	525.7024	315.0318	155.1971	0.0000	0.0000	0.0000	0.0000	303.3247	546.8424	781.0105	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8226	89.7745	89.6610	89.4026	88.8810	87.3000	87.3000	87.3000	87.3000	89.3478	89.6935	89.8495	(217)
Fuel for water heating, kWh/month													
	199.4740	175.0079	181.8987	160.5621	156.0928	138.8278	130.3257	147.1641	148.2179	166.7464	179.3524	193.6214	(219)
Water heating fuel used												1977.2914	(219)
Annual totals kWh/year													
Space heating fuel - main system												4005.3015	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5451.2752	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4005.3015	3.4800	139.3845	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.2914	3.4800	68.8097	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			258.1134	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7066	(257)
SAP value		90.1428	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4005.3015	0.2160	865.1451	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.2914	0.2160	427.0949	(264)
Space and water heating			1292.2401	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	1016.4862 (272)
CO2 emissions per m2	9.3800 (273)
EI value	91.1218
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8880 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8880 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3277	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3183	0.2955	0.3031	0.2880	0.2880	0.2804	0.2728	0.2652	0.2577	0.2804	0.2652	0.2804	(22b)
Effective ac	0.5507	0.5437	0.5459	0.5415	0.5415	0.5393	0.5372	0.5352	0.5332	0.5393	0.5352	0.5393	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.0916	50.4443	50.6547	50.2391	50.2391	50.0393	49.8448	49.6557	49.4718	50.0393	49.6557	50.0393	(38)
Heat transfer coeff	120.7037	120.0563	120.2668	119.8512	119.8512	119.6514	119.4569	119.2677	119.0839	119.6514	119.2677	119.6514	(39)
Average = Sum(39)m / 12 =												119.7299	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1133	1.1073	1.1093	1.1054	1.1054	1.1036	1.1018	1.1001	1.0984	1.1036	1.1001	1.1036	(40)
HLP (average)												1.1043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0969	34.2808	34.2208	34.3395	34.3395	34.3968	34.4528	34.5075	34.5607	34.3968	34.5075	34.3968	
alpha	3.2731	3.2854	3.2814	3.2893	3.2893	3.2931	3.2969	3.3005	3.3040	3.2931	3.3005	3.2931	
util living area													
	0.9704	0.9605	0.9312	0.8641	0.7492	0.5679	0.4314	0.4539	0.6982	0.8853	0.9531	0.9738	(86)
MIT	19.3661	19.5193	19.8797	20.3325	20.6991	20.9140	20.9740	20.9699	20.8238	20.3888	19.8290	19.3529	(87)
Th 2	19.9900	19.9949	19.9933	19.9964	19.9964	19.9979	19.9994	20.0008	20.0022	19.9979	20.0008	19.9979	(88)
util rest of house													
	0.9648	0.9531	0.9178	0.8369	0.6976	0.4856	0.3283	0.3468	0.6234	0.8555	0.9426	0.9687	(89)
MIT 2	17.8319	18.0553	18.5699	19.2036	19.6864	19.9325	19.9868	19.9860	19.8488	19.2957	18.5091	17.8183	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.0425	18.2563	18.7497	19.3585	19.8254	20.0672	20.1223	20.1210	19.9826	19.4457	18.6903	18.0289	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8925	18.1063	18.5997	19.2085	19.6754	19.9172	19.9723	19.9710	19.8326	19.2957	18.5403	17.8789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8937	0.8112	0.6789	0.4786	0.3254	0.3435	0.6091	0.8293	0.9215	0.9532	(94)
Useful gains	728.6361	779.1776	828.8184	835.6723	723.7588	521.7456	337.0522	335.3429	542.2415	657.5184	683.9166	695.5153	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	1568.2381	1537.4727	1395.0569	1163.5767	859.9754	552.4558	343.1113	342.4235	611.2116	944.7316	1269.0402	1540.9789	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.6639	509.5743	421.2814	236.0912	101.3451	0.0000	0.0000	0.0000	0.0000	213.6866	421.2890	629.0250	(98)
Space heating												3156.9565	(98)
Space heating per m2											(98) / (4) =	29.1178	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3488.3497	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.6639	509.5743	421.2814	236.0912	101.3451	0.0000	0.0000	0.0000	0.0000	213.6866	421.2890	629.0250	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.2363	563.0656	465.5044	260.8742	111.9835	0.0000	0.0000	0.0000	0.0000	236.1178	465.5127	695.0552	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7666	89.7249	89.5836	89.2628	88.6228	87.3000	87.3000	87.3000	87.3000	89.1575	89.5925	89.7870	(217)
Fuel for water heating, kWh/month													
	199.5986	175.1047	182.0559	160.8135	156.5477	138.8278	130.3257	147.1641	148.2179	167.1024	179.5545	193.7563	(219)
Water heating fuel used												1979.0690	(219)
Annual totals kWh/year													
Space heating fuel - main system												3488.3497	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4790.2758	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3488.3497	9.7400	339.7653	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.0690	9.7400	192.7613	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			386.9994	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3488.3497	0.2160	753.4835	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.0690	0.2160	427.4789	(264)
Space and water heating			1180.9624	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			829.5253	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3488.3497	1.2200	4255.7866	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Water heating (other fuel)	1979.0690	1.2200	2414.4642 (264)
Space and water heating			6670.2509 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			4591.4221 (272)
Primary energy kWh/m2/year			42.3485 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (23.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	1.80 kg/m²	B 91	A 93
Total Savings	£81	1.80 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£200	£219	-£18
Mains gas	£637	£537	£100
Space heating	£471	£471	£0
Water heating	£193	£111	£81
Lighting	£173	£173	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£387	£306	£82
Total cost of uses	£387	£305	£81
Delivered energy	44 kWh/m²	35 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	32 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.4200	
Infiltration rate				0.3277	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3215	53.0525	52.7887	51.5499	51.3181	50.2391	50.2391	50.0393	50.6547	51.3181	51.7870	52.2772	(38)
Heat transfer coeff	122.9336	122.6645	122.4008	121.1619	120.9301	119.8512	119.8512	119.6514	120.2668	120.9301	121.3990	121.8892	(39)
Average = Sum(39)m / 12 =												121.1608	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1339	1.1314	1.1289	1.1175	1.1154	1.1054	1.1054	1.1036	1.1093	1.1154	1.1197	1.1242	(40)
HLP (average)												1.1175	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
										Solar input (sum of months) = Sum(63)m =		-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
										Total per year (kWh/year) = Sum(64)m =		885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4785	33.5519	33.6242	33.9680	34.0331	34.3395	34.3395	34.3968	34.2208	34.0331	33.9016	33.7653	
alpha	3.2319	3.2368	3.2416	3.2645	3.2689	3.2893	3.2893	3.2931	3.2814	3.2689	3.2601	3.2510	
util living area	0.9756	0.9652	0.9421	0.8893	0.7935	0.6477	0.5055	0.5524	0.7619	0.9141	0.9643	0.9788	(86)
MIT	19.2010	19.3930	19.7417	20.2008	20.5958	20.8561	20.9528	20.9361	20.7403	20.2303	19.6383	19.1623	(87)
Th 2	19.9733	19.9753	19.9773	19.9865	19.9883	19.9964	19.9964	19.9979	19.9933	19.9883	19.9848	19.9811	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house

	0.9711	0.9587	0.9309	0.8668	0.7500	0.5729	0.4034	0.4502	0.6979	0.8919	0.9564	0.9748 (89)
MIT 2	17.5823	17.8609	18.3632	19.0167	19.5500	19.8735	19.9689	19.9578	19.7476	19.0716	18.2251	17.5312 (90)
Living area fraction										fLA = Living area / (4) =		0.1372 (91)
MIT	17.8045	18.0712	18.5523	19.1792	19.6935	20.0084	20.1039	20.0921	19.8838	19.2306	18.4191	17.7551 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6545	17.9212	18.4023	19.0292	19.5435	19.8584	19.9539	19.9421	19.7338	19.0806	18.2691	17.6051 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9403	0.9077	0.8405	0.7279	0.5616	0.3989	0.4441	0.6787	0.8659	0.9376	0.9610	(94)
Useful gains	711.9823	770.5362	817.3931	831.2987	759.7331	573.8556	388.8652	404.9185	569.8480	656.6017	668.5614	683.9170	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1641.7150	1597.2372	1456.8564	1227.2763	948.5146	630.2198	401.9725	423.8175	677.5606	1025.5653	1355.9119	1633.9365	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	691.7211	555.5431	475.7607	285.1038	140.4534	0.0000	0.0000	0.0000	0.0000	274.5089	494.8924	706.8145	(98)
Space heating												3624.7979	(98)
Space heating per m2											(98) / (4) =	33.4329	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4005.3015	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	691.7211	555.5431	475.7607	285.1038	140.4534	0.0000	0.0000	0.0000	0.0000	274.5089	494.8924	706.8145	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	764.3327	613.8597	525.7024	315.0318	155.1971	0.0000	0.0000	0.0000	0.0000	303.3247	546.8424	781.0105	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9006	89.9355	89.9705	90.0335	90.0995	87.3000	87.3000	87.3000	87.3000	89.6559	89.8119	89.9143	(217)
Fuel for water heating, kWh/month	171.0876	127.6327	101.1522	52.1345	21.5159	4.4162	0.0000	31.2800	57.4574	105.8233	145.6176	169.8755	(219)
Water heating fuel used												987.9930	(219)
Annual totals kWh/year													
Space heating fuel - main system												4005.3015	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4511.9768	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4005.3015	3.4800	139.3845	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9930	3.4800	34.3822	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			230.2808	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6304	(257)
SAP value		91.2057	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4005.3015	0.2160	865.1451	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9930	0.2160	213.4065	(264)
Space and water heating			1078.5516	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			828.7477	(272)
CO2 emissions per m2			7.6400	(273)
EI value			92.7616	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.4200	
Infiltration rate			0.3277	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3031	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3183	0.2955	0.3031	0.2880	0.2880	0.2804	0.2728	0.2652	0.2577	0.2804	0.2652	0.2804	(22b)
Effective ac	0.5507	0.5437	0.5459	0.5415	0.5415	0.5393	0.5372	0.5352	0.5332	0.5393	0.5352	0.5393	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.0916	50.4443	50.6547	50.2391	50.2391	50.0393	49.8448	49.6557	49.4718	50.0393	49.6557	50.0393	(38)
Heat transfer coeff	120.7037	120.0563	120.2668	119.8512	119.8512	119.6514	119.4569	119.2677	119.0839	119.6514	119.2677	119.6514	(39)
Average = Sum(39)m / 12 =												119.7299	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1133	1.1073	1.1093	1.1054	1.1054	1.1036	1.1018	1.1001	1.0984	1.1036	1.1001	1.1036	(40)
HLP (average)												1.1043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
								Solar input (sum of months) = Sum(63)m =				-910.5697	(63)
Output from w/h													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
									Total per year (kWh/year) = Sum(64)m =			855.9781	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	108.0780	179.6227	298.9419	442.2855	519.8980	580.8695	547.5213	478.0760	368.2097	230.0150	134.2116	87.4630	(83)
Total gains	768.4781	834.4424	927.4030	1030.1427	1066.0718	1090.2490	1035.8929	976.2574	890.2381	792.8779	742.1762	729.6499	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0969	34.2808	34.2208	34.3395	34.3395	34.3968	34.4528	34.5075	34.5607	34.3968	34.5075	34.3968	
alpha	3.2731	3.2854	3.2814	3.2893	3.2893	3.2931	3.2969	3.3005	3.3040	3.2931	3.3005	3.2931	
util living area													
	0.9704	0.9605	0.9312	0.8641	0.7492	0.5679	0.4314	0.4539	0.6982	0.8853	0.9531	0.9738	(86)
MIT	19.3661	19.5193	19.8797	20.3325	20.6991	20.9140	20.9740	20.9699	20.8238	20.3888	19.8290	19.3529	(87)
Th 2	19.9900	19.9949	19.9933	19.9964	19.9964	19.9979	19.9994	20.0008	20.0022	19.9979	20.0008	19.9979	(88)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9648	0.9531	0.9178	0.8369	0.6976	0.4856	0.3283	0.3468	0.6234	0.8555	0.9426	0.9687	(89)
MIT 2	17.8319	18.0553	18.5699	19.2036	19.6864	19.9325	19.9868	19.9860	19.8488	19.2957	18.5091	17.8183	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.0425	18.2563	18.7497	19.3585	19.8254	20.0672	20.1223	20.1210	19.9826	19.4457	18.6903	18.0289	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8925	18.1063	18.5997	19.2085	19.6754	19.9172	19.9723	19.9710	19.8326	19.2957	18.5403	17.8789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9338	0.8937	0.8112	0.6789	0.4786	0.3254	0.3435	0.6091	0.8293	0.9215	0.9532	(94)
Useful gains	728.6361	779.1776	828.8184	835.6723	723.7588	521.7456	337.0522	335.3429	542.2415	657.5184	683.9166	695.5153	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1568.2381	1537.4727	1395.0569	1163.5767	859.9754	552.4558	343.1113	342.4235	611.2116	944.7316	1269.0402	1540.9789	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.6639	509.5743	421.2814	236.0912	101.3451	0.0000	0.0000	0.0000	0.0000	213.6866	421.2890	629.0250	(98)
Space heating												3156.9565	(98)
Space heating per m2											(98) / (4) =	29.1178	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3488.3497	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.6639	509.5743	421.2814	236.0912	101.3451	0.0000	0.0000	0.0000	0.0000	213.6866	421.2890	629.0250	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.2363	563.0656	465.5044	260.8742	111.9835	0.0000	0.0000	0.0000	0.0000	236.1178	465.5127	695.0552	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8640	89.8938	89.9172	89.9662	89.8759	87.3000	87.3000	87.3000	87.3000	89.5222	89.7439	89.8673	(217)
Fuel for water heating, kWh/month													
	166.3267	127.7885	100.6416	50.6803	26.3552	0.0000	0.0000	23.8211	51.6488	101.3143	140.1034	166.4029	(219)
Water heating fuel used												955.0828	(219)
Annual totals kWh/year													
Space heating fuel - main system												3488.3497	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3816.2896	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3488.3497	9.7400	339.7653	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.0828	9.7400	93.0251	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			305.6882	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3488.3497	0.2160	753.4835	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.0828	0.2160	206.2979	(264)
Space and water heating			959.7814	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			634.2942	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3488.3497	1.2200	4255.7866	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.0828	1.2200	1165.2010	(264)
Space and water heating			5420.9876	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3495.6589	(272)
Primary energy kWh/m2/year			32.2418	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.61	(37)
Summer heat loss coefficient	440.75	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-314	**Issued on Date**	15/03/2023
Assessment Reference	As Built	**Prop Type Ref**	3T-Opp-SEMI
Property	23, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	90 B	**DER**	10.55	**TER**	17.43
Environmental	91 B	**% DER<TER**	39.47		
CO_2 Emissions (t/year)	0.80	**DFEE**	45.56	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.62		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.55 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.50 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.5000	
Infiltration rate				0.3317	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3912	0.3835	0.3759	0.3375	0.3298	0.2915	0.2915	0.2838	0.3068	0.3298	0.3452	0.3605	(22b)
Effective ac	0.5765	0.5735	0.5706	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.4917	53.2161	52.9458	51.6766	51.4391	50.3336	50.3336	50.1289	50.7594	51.4391	51.9195	52.4217	(38)
Heat transfer coeff	123.1038	122.8281	122.5579	121.2886	121.0511	119.9457	119.9457	119.7409	120.3715	121.0511	121.5315	122.0338	(39)
Average = Sum(39)m / 12 =												121.2875	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1354	1.1329	1.1304	1.1187	1.1165	1.1063	1.1063	1.1044	1.1102	1.1165	1.1209	1.1256	(40)
HLP (average)												1.1187	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4322	33.5072	33.5811	33.9325	33.9991	34.3124	34.3124	34.3711	34.1911	33.9991	33.8647	33.7253	
alpha	3.2288	3.2338	3.2387	3.2622	3.2666	3.2875	3.2875	3.2914	3.2794	3.2666	3.2576	3.2484	
util living area	0.9891	0.9812	0.9636	0.9223	0.8420	0.7100	0.5673	0.6160	0.8180	0.9468	0.9826	0.9910	(86)
MIT	18.9615	19.1871	19.5694	20.0642	20.5020	20.8087	20.9334	20.9113	20.6696	20.0868	19.4333	18.9213	(87)
Th 2	19.9720	19.9741	19.9761	19.9856	19.9874	19.9957	19.9957	19.9972	19.9925	19.9874	19.9838	19.9800	(88)
util rest of house	0.9870	0.9774	0.9560	0.9049	0.8041	0.6366	0.4586	0.5094	0.7608	0.9315	0.9785	0.9892	(89)
MIT 2	17.2352	17.5644	18.1189	18.8311	19.4345	19.8268	19.9555	19.9395	19.6688	18.8757	17.9309	17.1814	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4721	17.7871	18.3180	19.0003	19.5810	19.9616	20.0897	20.0729	19.8061	19.0419	18.1371	17.4202	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3221	17.6371	18.1680	18.8503	19.4310	19.8116	19.9397	19.9229	19.6561	18.8919	17.9871	17.2702	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9645	0.9370	0.8796	0.7791	0.6214	0.4520	0.5006	0.7376	0.9084	0.9660	0.9816	(94)
Useful gains	546.0666	630.4273	703.3599	744.4766	703.5893	549.3851	381.6685	395.0086	530.7109	565.1444	529.3859	516.2391	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1603.0730	1564.4754	1430.0027	1206.8631	935.8436	625.1058	400.5844	421.8311	668.7977	1003.7460	1323.1256	1595.0053 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	786.4127	627.6804	540.6222	332.9183	172.7972	0.0000	0.0000	0.0000	0.0000	326.3196	571.4926	802.6021 (98)
Space heating												4160.8450 (98)
Space heating per m2											(98) / (4) =	38.3771 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4597.6188 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	786.4127	627.6804	540.6222	332.9183	172.7972	0.0000	0.0000	0.0000	0.0000	326.3196	571.4926	802.6021	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	868.9643	693.5694	597.3726	367.8655	190.9361	0.0000	0.0000	0.0000	0.0000	360.5742	631.4835	886.8531	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8886	89.8407	89.7377	89.5115	89.0464	87.3000	87.3000	87.3000	87.3000	89.4720	89.7772	89.9129	(217)
Fuel for water heating, kWh/month													
	199.3276	174.8790	181.7433	160.3668	155.8029	138.8278	130.3257	147.1641	148.2179	166.5150	179.1852	193.4849	(219)
Water heating fuel used												1975.8402	(219)
Annual totals kWh/year													
Space heating fuel - main system												4597.6188	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =											-1074.8994	-1074.8994	(233)
Total delivered energy for all uses												6042.1413	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4597.6188	0.2160	993.0857	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.8402	0.2160	426.7815	(264)
Space and water heating			1419.8671	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1144.1133	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.5500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.5500	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		26.9855	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.9855	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4859	(36)
Total fabric heat loss (33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4895.2099	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month													
	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1423	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3673	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3397	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4331	0.4247	0.4162	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992	(22b)
Effective ac	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0959	54.7579	54.4266	52.8706	52.5794	51.2242	51.2242	50.9732	51.7462	52.5794	53.1684	53.7841	(38)
Heat transfer coeff	124.7079	124.3699	124.0387	122.4826	122.1915	120.8362	120.8362	120.5853	121.3583	122.1915	122.7804	123.3962	(39)
Average = Sum(39)m / 12 =												122.4812	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1502	1.1471	1.1441	1.1297	1.1270	1.1145	1.1145	1.1122	1.1193	1.1270	1.1325	1.1381	(40)
HLP (average)												1.1297	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5054	32.5937	32.6808	33.0959	33.1748	33.5469	33.5469	33.6167	33.4026	33.1748	33.0157	32.8509	
alpha	3.1670	3.1729	3.1787	3.2064	3.2117	3.2365	3.2365	3.2411	3.2268	3.2117	3.2010	3.1901	
util living area													
	0.9905	0.9831	0.9668	0.9276	0.8511	0.7227	0.5814	0.6319	0.8302	0.9520	0.9848	0.9922	(86)
MIT	18.8672	19.0987	19.4921	20.0064	20.4624	20.7891	20.9247	20.8997	20.6388	20.0297	19.3565	18.8313	(87)
Th 2	19.9600	19.9625	19.9650	19.9766	19.9788	19.9890	19.9890	19.9909	19.9851	19.9788	19.9744	19.9698	(88)
util rest of house													
	0.9886	0.9798	0.9598	0.9113	0.8146	0.6501	0.4713	0.5246	0.7751	0.9381	0.9812	0.9907	(89)
MIT 2	18.0028	18.2345	18.6256	19.1367	19.5687	19.8606	19.9575	19.9456	19.7408	19.1685	18.5010	17.9741	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.1214	18.3531	18.7446	19.2560	19.6914	19.9880	20.0903	20.0765	19.8641	19.2867	18.6184	18.0917	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1214	18.3531	18.7446	19.2560	19.6914	19.9880	20.0903	20.0765	19.8641	19.2867	18.6184	18.0917	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9839	0.9726	0.9489	0.8970	0.8025	0.6500	0.4832	0.5346	0.7673	0.9257	0.9745	0.9866	(94)
Useful gains	515.3648	603.0148	682.0778	732.7631	702.3568	557.9074	396.4584	407.7890	531.2961	548.5051	502.4683	485.6999	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1723.6399	1673.1664	1518.7984	1268.4338	976.4785	651.0651	421.7496	443.3344	699.5170	1061.4449	1414.2362	1714.1829	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	898.9567	719.1419	622.5201	385.6829	203.9465	0.0000	0.0000	0.0000	0.0000	381.6272	656.4729	913.9914	(98)
Space heating												4782.3395	(98)
Space heating per m2											(98) / (4) =	44.1094	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1135.8605	894.1881	916.4479	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7564	0.8266	0.7971	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	859.1903	739.1276	730.5431	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	183.3486	244.1542	202.0419	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												629.5447	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.8371	61.0386	50.5105	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												157.3862	(107)
Space cooling per m2												1.4516	(108)
Energy for space heating												44.1094	(99)
Energy for space cooling												1.4516	(108)
Total												45.5610	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.5000	
Infiltration rate				0.3317	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3222	0.2992	0.3068	0.2915	0.2915	0.2838	0.2761	0.2685	0.2608	0.2838	0.2685	0.2838	(22b)
Effective ac	0.5519	0.5447	0.5471	0.5425	0.5425	0.5403	0.5381	0.5360	0.5340	0.5403	0.5360	0.5403	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.2071	50.5438	50.7594	50.3336	50.3336	50.1289	49.9296	49.7358	49.5475	50.1289	49.7358	50.1289	(38)
Heat transfer coeff	120.8191	120.1558	120.3715	119.9457	119.9457	119.7409	119.5417	119.3479	119.1595	119.7409	119.3479	119.7409	(39)
Average = Sum(39)m / 12 =												119.8215	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1144	1.1082	1.1102	1.1063	1.1063	1.1044	1.1026	1.1008	1.0991	1.1044	1.1008	1.1044	(40)
HLP (average)												1.1052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0644	34.2524	34.1911	34.3124	34.3124	34.3711	34.4284	34.4843	34.5388	34.3711	34.4843	34.3711	
alpha	3.2710	3.2835	3.2794	3.2875	3.2875	3.2914	3.2952	3.2990	3.3026	3.2914	3.2990	3.2914	
util living area	0.9664	0.9541	0.9212	0.8516	0.7379	0.5583	0.4217	0.4385	0.6729	0.8678	0.9457	0.9704	(86)
MIT	19.4097	19.5749	19.9341	20.3673	20.7129	20.9181	20.9756	20.9728	20.8427	20.4342	19.8773	19.3912	(87)
Th 2	19.9891	19.9941	19.9925	19.9957	19.9957	19.9972	19.9987	20.0002	20.0016	19.9972	20.0002	19.9972	(88)
util rest of house	0.9601	0.9457	0.9063	0.8229	0.6856	0.4766	0.3204	0.3342	0.5974	0.8352	0.9339	0.9648	(89)
MIT 2	17.8938	18.1338	18.6448	19.2484	19.7014	19.9352	19.9870	19.9869	19.8666	19.3537	18.5765	17.8729	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.1018	18.3316	18.8217	19.4020	19.8403	20.0701	20.1227	20.1222	20.0005	19.5020	18.7550	18.0813	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9518	18.1816	18.6717	19.2520	19.6903	19.9201	19.9727	19.9722	19.8505	19.3520	18.6050	17.9313	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9422	0.9250	0.8814	0.7976	0.6677	0.4699	0.3177	0.3311	0.5847	0.8093	0.9115	0.9483	(94)
Useful gains	759.7542	817.7242	865.5586	858.4761	732.5007	524.0296	337.7484	336.4329	552.4301	686.2620	716.6429	722.8022	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	1576.9100	1547.7993	1404.9413	1169.7076	862.4412	553.2185	343.4041	342.7959	613.7348	952.1751	1277.6208	1548.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	607.9640	490.6104	401.3007	224.0867	96.6757	0.0000	0.0000	0.0000	0.0000	197.8394	403.9041	614.2503	(98)
Space heating												3036.6312	(98)
RHI space heating demand												3037	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.5000	
Infiltration rate			0.3317	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3912	0.3835	0.3759	0.3375	0.3298	0.2915	0.2915	0.2838	0.3068	0.3298	0.3452	0.3605	(22b)
Effective ac	0.5765	0.5735	0.5706	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.4917	53.2161	52.9458	51.6766	51.4391	50.3336	50.3336	50.1289	50.7594	51.4391	51.9195	52.4217	(38)
Heat transfer coeff	123.1038	122.8281	122.5579	121.2886	121.0511	119.9457	119.9457	119.7409	120.3715	121.0511	121.5315	122.0338	(39)
Average = Sum(39)m / 12 =												121.2875	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1354	1.1329	1.1304	1.1187	1.1165	1.1063	1.1063	1.1044	1.1102	1.1165	1.1209	1.1256	(40)
HLP (average)												1.1187	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4322	33.5072	33.5811	33.9325	33.9991	34.3124	34.3124	34.3711	34.1911	33.9991	33.8647	33.7253	
alpha	3.2288	3.2338	3.2387	3.2622	3.2666	3.2875	3.2875	3.2914	3.2794	3.2666	3.2576	3.2484	
util living area	0.9727	0.9595	0.9332	0.8777	0.7816	0.6367	0.4935	0.5342	0.7381	0.9006	0.9592	0.9764	(86)
MIT	19.2367	19.4479	19.7980	20.2406	20.6150	20.8632	20.9559	20.9420	20.7653	20.2775	19.6797	19.1940	(87)
Th 2	19.9720	19.9741	19.9761	19.9856	19.9874	19.9957	19.9957	19.9972	19.9925	19.9874	19.9838	19.9800	(88)
util rest of house	0.9677	0.9521	0.9206	0.8536	0.7371	0.5619	0.3930	0.4337	0.6721	0.8758	0.9505	0.9720	(89)
MIT 2	17.6329	17.9384	18.4411	19.0690	19.5721	19.8795	19.9702	19.9613	19.7734	19.1339	18.2832	17.5763	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8530	18.1455	18.6274	19.2298	19.7152	20.0145	20.1055	20.0959	19.9096	19.2909	18.4749	17.7984	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7030	17.9955	18.4774	19.0798	19.5652	19.8645	19.9555	19.9459	19.7596	19.1409	18.3249	17.6484	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9323	0.8963	0.8273	0.7157	0.5512	0.3887	0.4282	0.6546	0.8494	0.9304	0.9574	(94)
Useful gains	738.7749	809.8285	856.4916	857.8718	772.1842	577.9551	390.2925	407.5518	584.1813	687.4806	697.8472	707.7329	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

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	1649.9598	1608.4995	1467.9195	1234.6887	952.0972	631.4527	402.4748	424.5865	681.2498	1033.8805	1364.1735	1641.1545 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	677.9216	536.7070	454.9024	271.3082	133.8552	0.0000	0.0000	0.0000	0.0000	257.7215	479.7550	694.4657 (98)
Space heating												3506.6365 (98)
Space heating per m2											(98) / (4) =	32.3431 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3874.7364	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	677.9216	536.7070	454.9024	271.3082	133.8552	0.0000	0.0000	0.0000	0.0000	257.7215	479.7550	694.4657	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	749.0846	593.0464	502.6546	299.7881	147.9063	0.0000	0.0000	0.0000	0.0000	284.7751	530.1160	767.3654	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8118	89.7550	89.6329	89.3665	88.8426	87.3000	87.3000	87.3000	87.3000	89.3009	89.6746	89.8403	(217)
Fuel for water heating, kWh/month													
	199.4981	175.0460	181.9556	160.6269	156.1604	138.8278	130.3257	147.1641	148.2179	166.8340	179.3902	193.6412	(219)
Water heating fuel used												1977.6879	(219)
Annual totals kWh/year													
Space heating fuel - main system												3874.7364	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5321.1067	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3874.7364	3.4800	134.8408	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.6879	3.4800	68.8235	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			253.5836	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6942	(257)
SAP value		90.3158	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3874.7364	0.2160	836.9431	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.6879	0.2160	427.1806	(264)
Space and water heating			1264.1237	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	988.3698 (272)
CO2 emissions per m2	9.1200 (273)
EI value	91.3674
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.920, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			4.5000	
Infiltration rate			0.3317	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3222	0.2992	0.3068	0.2915	0.2915	0.2838	0.2761	0.2685	0.2608	0.2838	0.2685	0.2838	(22b)
Effective ac	0.5519	0.5447	0.5471	0.5425	0.5425	0.5403	0.5381	0.5360	0.5340	0.5403	0.5360	0.5403	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.2071	50.5438	50.7594	50.3336	50.3336	50.1289	49.9296	49.7358	49.5475	50.1289	49.7358	50.1289	(38)
Heat transfer coeff	120.8191	120.1558	120.3715	119.9457	119.9457	119.7409	119.5417	119.3479	119.1595	119.7409	119.3479	119.7409	(39)
Average = Sum(39)m / 12 =												119.8215	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1144	1.1082	1.1102	1.1063	1.1063	1.1044	1.1026	1.1008	1.0991	1.1044	1.1008	1.1044	(40)
HLP (average)												1.1052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0644	34.2524	34.1911	34.3124	34.3124	34.3711	34.4284	34.4843	34.5388	34.3711	34.4843	34.3711	
alpha	3.2710	3.2835	3.2794	3.2875	3.2875	3.2914	3.2952	3.2990	3.3026	3.2914	3.2990	3.2914	
util living area													
	0.9664	0.9541	0.9212	0.8516	0.7379	0.5583	0.4217	0.4385	0.6729	0.8678	0.9457	0.9704	(86)
MIT	19.4097	19.5749	19.9341	20.3673	20.7129	20.9181	20.9756	20.9728	20.8427	20.4342	19.8773	19.3912	(87)
Th 2	19.9891	19.9941	19.9925	19.9957	19.9957	19.9972	19.9987	20.0002	20.0016	19.9972	20.0002	19.9972	(88)
util rest of house													
	0.9601	0.9457	0.9063	0.8229	0.6856	0.4766	0.3204	0.3342	0.5974	0.8352	0.9339	0.9648	(89)
MIT 2	17.8938	18.1338	18.6448	19.2484	19.7014	19.9352	19.9870	19.9869	19.8666	19.3537	18.5765	17.8729	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.1018	18.3316	18.8217	19.4020	19.8403	20.0701	20.1227	20.1222	20.0005	19.5020	18.7550	18.0813	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9518	18.1816	18.6717	19.2520	19.6903	19.9201	19.9727	19.9722	19.8505	19.3520	18.6050	17.9313	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9422	0.9250	0.8814	0.7976	0.6677	0.4699	0.3177	0.3311	0.5847	0.8093	0.9115	0.9483	(94)
Useful gains	759.7542	817.7242	865.5586	858.4761	732.5007	524.0296	337.7484	336.4329	552.4301	686.2620	716.6429	722.8022	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	1576.9100	1547.7993	1404.9413	1169.7076	862.4412	553.2185	343.4041	342.7959	613.7348	952.1751	1277.6208	1548.4075 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	607.9640	490.6104	401.3007	224.0867	96.6757	0.0000	0.0000	0.0000	0.0000	197.8394	403.9041	614.2503 (98)
Space heating												3036.6312 (98)
Space heating per m2											(98) / (4) =	28.0080 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3355.3936 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	607.9640	490.6104	401.3007	224.0867	96.6757	0.0000	0.0000	0.0000	0.0000	197.8394	403.9041	614.2503	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	671.7834	542.1110	443.4262	247.6096	106.8240	0.0000	0.0000	0.0000	0.0000	218.6070	446.3028	678.7296	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7511	89.7024	89.5515	89.2230	88.5863	87.3000	87.3000	87.3000	87.3000	89.0971	89.5649	89.7737	(217)
Fuel for water heating, kWh/month													
	199.6329	175.1486	182.1212	160.8853	156.6121	138.8278	130.3257	147.1641	148.2179	167.2156	179.6099	193.7849	(219)
Water heating fuel used												1979.5460	(219)
Annual totals kWh/year													
Space heating fuel - main system												3355.3936	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												4657.7967	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3355.3936	9.7400	326.8153	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.5460	9.7400	192.8078	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			374.0960	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3355.3936	0.2160	724.7650	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.5460	0.2160	427.5819	(264)
Space and water heating			1152.3470	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			800.9098	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3355.3936	1.2200	4093.5802	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Water heating (other fuel)	1979.5460	1.2200	2415.0461 (264)
Space and water heating			6508.6263 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	468.5817	3.0700	1438.5460 (268)
Energy saving/generation technologies			
PV Unit	-1220.7247	3.0700	-3747.6247 (269)
Primary energy kWh/year			4429.7976 (272)
Primary energy kWh/m2/year			40.8578 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (24.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	1.80 kg/m²	B 91	A 93
Total Savings	£81	1.80 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£200	£219	-£18
Mains gas	£624	£524	£100
Space heating	£458	£458	£0
Water heating	£193	£111	£81
Lighting	£173	£173	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£374	£293	£82
Total cost of uses	£374	£292	£81
Delivered energy	43 kWh/m²	34 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	6 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	31 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.5000	
Infiltration rate				0.3317	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3912	0.3835	0.3759	0.3375	0.3298	0.2915	0.2915	0.2838	0.3068	0.3298	0.3452	0.3605	(22b)
Effective ac	0.5765	0.5735	0.5706	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.4917	53.2161	52.9458	51.6766	51.4391	50.3336	50.3336	50.1289	50.7594	51.4391	51.9195	52.4217	(38)
Heat transfer coeff	123.1038	122.8281	122.5579	121.2886	121.0511	119.9457	119.9457	119.7409	120.3715	121.0511	121.5315	122.0338	(39)
Average = Sum(39)m / 12 =												121.2875	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1354	1.1329	1.1304	1.1187	1.1165	1.1063	1.1063	1.1044	1.1102	1.1165	1.1209	1.1256	(40)
HLP (average)												1.1187	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
										Solar input (sum of months) = Sum(63)m =		-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
										Total per year (kWh/year) = Sum(64)m =		885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4322	33.5072	33.5811	33.9325	33.9991	34.3124	34.3124	34.3711	34.1911	33.9991	33.8647	33.7253	
alpha	3.2288	3.2338	3.2387	3.2622	3.2666	3.2875	3.2875	3.2914	3.2794	3.2666	3.2576	3.2484	
util living area	0.9727	0.9595	0.9332	0.8777	0.7816	0.6367	0.4935	0.5342	0.7381	0.9006	0.9592	0.9764	(86)
MIT	19.2367	19.4479	19.7980	20.2406	20.6150	20.8632	20.9559	20.9420	20.7653	20.2775	19.6797	19.1940	(87)
Th 2	19.9720	19.9741	19.9761	19.9856	19.9874	19.9957	19.9957	19.9972	19.9925	19.9874	19.9838	19.9800	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9677	0.9521	0.9206	0.8536	0.7371	0.5619	0.3930	0.4337	0.6721	0.8758	0.9505	0.9720	(89)
MIT 2	17.6329	17.9384	18.4411	19.0690	19.5721	19.8795	19.9702	19.9613	19.7734	19.1339	18.2832	17.5763	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.8530	18.1455	18.6274	19.2298	19.7152	20.0145	20.1055	20.0959	19.9096	19.2909	18.4749	17.7984	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7030	17.9955	18.4774	19.0798	19.5652	19.8645	19.9555	19.9459	19.7596	19.1409	18.3249	17.6484	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9323	0.8963	0.8273	0.7157	0.5512	0.3887	0.4282	0.6546	0.8494	0.9304	0.9574	(94)
Useful gains	738.7749	809.8285	856.4916	857.8718	772.1842	577.9551	390.2925	407.5518	584.1813	687.4806	697.8472	707.7329	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1649.9598	1608.4995	1467.9195	1234.6887	952.0972	631.4527	402.4748	424.5865	681.2498	1033.8805	1364.1735	1641.1545	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	677.9216	536.7070	454.9024	271.3082	133.8552	0.0000	0.0000	0.0000	0.0000	257.7215	479.7550	694.4657	(98)
Space heating												3506.6365	(98)
Space heating per m2											(98) / (4) =	32.3431	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3874.7364	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	677.9216	536.7070	454.9024	271.3082	133.8552	0.0000	0.0000	0.0000	0.0000	257.7215	479.7550	694.4657	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	749.0846	593.0464	502.6546	299.7881	147.9063	0.0000	0.0000	0.0000	0.0000	284.7751	530.1160	767.3654	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8907	89.9193	89.9503	90.0134	90.0823	87.3000	87.3000	87.3000	87.3000	89.6161	89.7949	89.9059	(217)
Fuel for water heating, kWh/month													
	171.1064	127.6558	101.1748	52.1462	21.5200	4.4162	0.0000	31.2800	57.4574	105.8703	145.6451	169.8915	(219)
Water heating fuel used												988.1637	(219)
Annual totals kWh/year													
Space heating fuel - main system												3874.7364	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4381.5824	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3874.7364	3.4800	134.8408	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.1637	3.4800	34.3881	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			225.7431	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6180	(257)
SAP value		91.3790	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3874.7364	0.2160	836.9431	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.1637	0.2160	213.4434	(264)
Space and water heating			1050.3864	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			800.5826	(272)
CO2 emissions per m2			7.3800	(273)
EI value			93.0076	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				4.5000	
Infiltration rate				0.3317	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3222	0.2992	0.3068	0.2915	0.2915	0.2838	0.2761	0.2685	0.2608	0.2838	0.2685	0.2838	(22b)
Effective ac	0.5519	0.5447	0.5471	0.5425	0.5425	0.5403	0.5381	0.5360	0.5340	0.5403	0.5360	0.5403	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.2071	50.5438	50.7594	50.3336	50.3336	50.1289	49.9296	49.7358	49.5475	50.1289	49.7358	50.1289	(38)
Heat transfer coeff	120.8191	120.1558	120.3715	119.9457	119.9457	119.7409	119.5417	119.3479	119.1595	119.7409	119.3479	119.7409	(39)
Average = Sum(39)m / 12 =												119.8215	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1144	1.1082	1.1102	1.1063	1.1063	1.1044	1.1026	1.1008	1.0991	1.1044	1.1008	1.1044	(40)
HLP (average)												1.1052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2795	(H8)
Utilisation factor												0.5423	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-910.5697	(H17)
Solar input	-29.7050	-42.2386	-72.5980	-97.9515	-115.0499	-122.8915	-120.3071	-107.6785	-84.3048	-58.2855	-35.1332	-24.4261	(63)
										Solar input (sum of months) = Sum(63)m =		-910.5697	(63)
Output from w/h													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
										Total per year (kWh/year) = Sum(64)m =		855.9781	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	25.1925	0.4600	0.0000	0.7700	36.7636	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	6.6700	25.1925	0.4600	0.0000	0.7700	59.5177	(80)

Solar gains	145.9355	229.1802	353.6165	488.4842	550.8400	605.7681	574.8163	517.8824	422.8550	285.0959	178.2584	120.0524	(83)
Total gains	806.3356	883.9999	982.0776	1076.3414	1097.0138	1115.1477	1063.1879	1016.0639	944.8833	847.9588	786.2230	762.2392	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0644	34.2524	34.1911	34.3124	34.3124	34.3711	34.4284	34.4843	34.5388	34.3711	34.4843	34.3711	
alpha	3.2710	3.2835	3.2794	3.2875	3.2875	3.2914	3.2952	3.2990	3.3026	3.2914	3.2990	3.2914	
util living area													
	0.9664	0.9541	0.9212	0.8516	0.7379	0.5583	0.4217	0.4385	0.6729	0.8678	0.9457	0.9704	(86)
MIT	19.4097	19.5749	19.9341	20.3673	20.7129	20.9181	20.9756	20.9728	20.8427	20.4342	19.8773	19.3912	(87)
Th 2	19.9891	19.9941	19.9925	19.9957	19.9957	19.9972	19.9987	20.0002	20.0016	19.9972	20.0002	19.9972	(88)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9601	0.9457	0.9063	0.8229	0.6856	0.4766	0.3204	0.3342	0.5974	0.8352	0.9339	0.9648	(89)
MIT 2	17.8938	18.1338	18.6448	19.2484	19.7014	19.9352	19.9870	19.9869	19.8666	19.3537	18.5765	17.8729	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.1018	18.3316	18.8217	19.4020	19.8403	20.0701	20.1227	20.1222	20.0005	19.5020	18.7550	18.0813	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9518	18.1816	18.6717	19.2520	19.6903	19.9201	19.9727	19.9722	19.8505	19.3520	18.6050	17.9313	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9422	0.9250	0.8814	0.7976	0.6677	0.4699	0.3177	0.3311	0.5847	0.8093	0.9115	0.9483	(94)
Useful gains	759.7542	817.7242	865.5586	858.4761	732.5007	524.0296	337.7484	336.4329	552.4301	686.2620	716.6429	722.8022	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1576.9100	1547.7993	1404.9413	1169.7076	862.4412	553.2185	343.4041	342.7959	613.7348	952.1751	1277.6208	1548.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	607.9640	490.6104	401.3007	224.0867	96.6757	0.0000	0.0000	0.0000	0.0000	197.8394	403.9041	614.2503	(98)
Space heating												3036.6312	(98)
Space heating per m2											(98) / (4) =	28.0080	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3355.3936	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	607.9640	490.6104	401.3007	224.0867	96.6757	0.0000	0.0000	0.0000	0.0000	197.8394	403.9041	614.2503	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	671.7834	542.1110	443.4262	247.6096	106.8240	0.0000	0.0000	0.0000	0.0000	218.6070	446.3028	678.7296	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.4678	114.8740	90.4941	45.5952	23.6870	0.0000	0.0000	20.7958	45.0894	90.6988	125.7342	149.5417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8501	89.8750	89.8937	89.9426	89.8518	87.3000	87.3000	87.3000	87.3000	89.4691	89.7193	89.8551	(217)
Fuel for water heating, kWh/month													
	166.3524	127.8153	100.6680	50.6936	26.3623	0.0000	0.0000	23.8211	51.6488	101.3744	140.1418	166.4254	(219)
Water heating fuel used												955.3031	(219)
Annual totals kWh/year													
Space heating fuel - main system												3355.3936	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3683.5538	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3355.3936	9.7400	326.8153	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.3031	9.7400	93.0465	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	468.5817	36.8500	172.6724	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			292.7597	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3355.3936	0.2160	724.7650	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.3031	0.2160	206.3455	(264)
Space and water heating			931.1105	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			605.6233	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3355.3936	1.2200	4093.5802	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.3031	1.2200	1165.4698	(264)
Space and water heating			5259.0499	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3333.7212	(272)
Primary energy kWh/m2/year			30.7482	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.61	(37)
Summer heat loss coefficient	440.75	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	125.2818	0.4600	0.0000	0.9000	213.6906
South	2.4700	118.5567	0.4600	0.0000	0.9000	121.2337
West	6.6700	125.2818	0.4600	0.0000	0.9000	345.9506
total:						680.8749

	Jun	Jul	Aug	
Solar gains	729	681	611	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1236	1166	1107	(P5)
Summer gain/loss ratio	2.80	2.65	2.51	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.25	20.99	20.85	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-315	**Issued on Date**	10/08/2023
Assessment Reference	As Built	**Prop Type Ref**	2-As-SEMI
Property	25, Goldcrest Road, BOTLEY, SO32 2BZ		

SAP Rating	92 A	**DER**	9.11	**TER**	18.65
Environmental	93 A	**% DER<TER**	51.15		
CO_2 Emissions (t/year)	0.44	**DFEE**	46.49	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.99		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.11 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.00 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 9.19 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 3.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	100.1422	99.8542	99.5720	98.2462	97.9982	96.8435	96.8435	96.6297	97.2883	97.9982	98.5000	99.0246	(39)
Average = Sum(39)m / 12 =												98.2450	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2468	1.2432	1.2397	1.2232	1.2201	1.2057	1.2057	1.2031	1.2113	1.2201	1.2263	1.2329	(40)
HLP (average)												1.2232	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7738	32.8683	32.9615	33.4063	33.4908	33.8902	33.8902	33.9652	33.7352	33.4908	33.3202	33.1437	
alpha	3.1849	3.1912	3.1974	3.2271	3.2327	3.2593	3.2593	3.2643	3.2490	3.2327	3.2213	3.2096	
util living area													
	0.9844	0.9707	0.9402	0.8715	0.7559	0.6005	0.4615	0.5117	0.7365	0.9172	0.9742	0.9873	(86)
MIT	19.0161	19.2913	19.7225	20.2440	20.6457	20.8821	20.9626	20.9474	20.7612	20.2014	19.5104	18.9714	(87)
Th 2	19.8828	19.8856	19.8884	19.9015	19.9040	19.9154	19.9154	19.9176	19.9110	19.9040	19.8990	19.8938	(88)
util rest of house													
	0.9812	0.9647	0.9277	0.8445	0.7054	0.5203	0.3577	0.4056	0.6647	0.8937	0.9679	0.9846	(89)
MIT 2	17.2498	17.6492	18.2689	19.0055	19.5356	19.8214	19.8958	19.8877	19.6965	18.9668	17.9790	17.1915	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6922	18.0606	18.6330	19.3157	19.8136	20.0871	20.1630	20.1531	19.9632	19.2761	18.3626	17.6373	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5422	17.9106	18.4830	19.1657	19.6636	19.9371	20.0130	20.0031	19.8132	19.1261	18.2126	17.4873	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9494	0.9068	0.8227	0.6930	0.5220	0.3674	0.4145	0.6574	0.8721	0.9537	0.9757	(94)
Useful gains	490.9354	583.8568	664.3860	702.3329	644.5355	478.7530	321.8024	335.1396	474.1585	522.6500	481.6209	461.4986	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1326.1056	1299.1601	1193.1710	1008.5682	780.4231	516.8652	330.5317	348.1693	555.8269	835.5403	1094.5949	1315.7720	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.3666	480.6838	393.4161	220.4894	101.1004	0.0000	0.0000	0.0000	0.0000	232.7904	441.3412	635.5795	(98)
Space heating												3126.7673	(98)
Space heating per m2											(98) / (4) =	38.9289	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3454.9915	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.3666	480.6838	393.4161	220.4894	101.1004	0.0000	0.0000	0.0000	0.0000	232.7904	441.3412	635.5795	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	686.5929	531.1423	434.7139	243.6347	111.7131	0.0000	0.0000	0.0000	0.0000	257.2269	487.6699	702.2977	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8056	89.7350	89.5879	89.2675	88.6786	87.3000	87.3000	87.3000	87.3000	89.2804	89.6695	89.8334	(217)
Fuel for water heating, kWh/month													
	184.9689	162.3487	168.8656	149.2624	145.3027	129.0595	121.2740	136.7748	137.7020	154.8990	166.4039	179.5764	(219)
Water heating fuel used												1836.4379	(219)
Annual totals kWh/year													
Space heating fuel - main system												3454.9915	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4498.9184	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3454.9915	0.2160	746.2782	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4379	0.2160	396.6706	(264)
Space and water heating			1142.9487	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			731.6356	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.1100	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		27.5683	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.5683	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9281	(36)
Total fabric heat loss	(33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	100.1422	99.8542	99.5720	98.2462	97.9982	96.8435	96.8435	96.6297	97.2883	97.9982	98.5000	99.0246	(39)
Average = Sum(39)m / 12 =												98.2450	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2468	1.2432	1.2397	1.2232	1.2201	1.2057	1.2057	1.2031	1.2113	1.2201	1.2263	1.2329	(40)
HLP (average)												1.2232	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7738	32.8683	32.9615	33.4063	33.4908	33.8902	33.8902	33.9652	33.7352	33.4908	33.3202	33.1437	
alpha	3.1849	3.1912	3.1974	3.2271	3.2327	3.2593	3.2593	3.2643	3.2490	3.2327	3.2213	3.2096	
util living area													
	0.9871	0.9746	0.9460	0.8800	0.7669	0.6123	0.4720	0.5249	0.7508	0.9259	0.9782	0.9896	(86)
MIT	18.9644	19.2432	19.6817	20.2149	20.6288	20.8751	20.9600	20.9433	20.7461	20.1664	19.4633	18.9202	(87)
Th 2	19.8828	19.8856	19.8884	19.9015	19.9040	19.9154	19.9154	19.9176	19.9110	19.9040	19.8990	19.8938	(88)
util rest of house													
	0.9843	0.9692	0.9345	0.8542	0.7173	0.5317	0.3665	0.4172	0.6802	0.9043	0.9728	0.9873	(89)
MIT 2	18.0339	18.3117	18.7437	19.2636	19.6391	19.8470	19.9011	19.8954	19.7539	19.2321	18.5421	17.9981	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2670	18.5450	18.9787	19.5019	19.8870	20.1046	20.1663	20.1579	20.0024	19.4661	18.7728	18.2291	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2670	18.5450	18.9787	19.5019	19.8870	20.1046	20.1663	20.1579	20.0024	19.4661	18.7728	18.2291	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9227	0.8433	0.7164	0.5467	0.3919	0.4424	0.6868	0.8936	0.9652	0.9826	(94)
Useful gains	463.3165	560.4896	648.3980	696.4977	647.4989	488.0799	334.3571	346.6889	477.8336	510.6500	458.0932	433.7729	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1398.6885	1362.5157	1242.5275	1041.5963	802.3115	533.0814	345.3759	363.1255	574.2392	868.8631	1149.7742	1389.2230	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	695.9168	538.9616	442.0323	248.4710	115.1806	0.0000	0.0000	0.0000	0.0000	266.5105	498.0104	710.8549	(98)
Space heating												3515.9381	(98)
Space heating per m2											(98) / (4) =	43.7741	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	910.3291	716.6421	734.3857	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8419	0.8946	0.8696	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	766.3671	641.0900	638.6572	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	265.9122	332.1347	274.6631	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												872.7100	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.4781	83.0337	68.6658	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												218.1775	(107)
Space cooling per m2												2.7164	(108)
Energy for space heating												43.7741	(99)
Energy for space cooling												2.7164	(108)
Total												46.4905	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

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Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	44.2481	62.1032	49.3797	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												155.7311 (107)
Space cooling per m2												1.9389 (108)
Energy for space heating												45.0622 (99)
Energy for space cooling												1.9389 (108)
Total												47.0011 (109)
Target Fabric Energy Efficiency (TFEE)												54.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3831	0.3558	0.3649	0.3467	0.3467	0.3375	0.3284	0.3193	0.3102	0.3375	0.3193	0.3375	(22b)
Effective ac	0.5734	0.5633	0.5666	0.5601	0.5601	0.5570	0.5539	0.5510	0.5481	0.5570	0.5510	0.5570	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2877	38.5949	38.8201	38.3754	38.3754	38.1616	37.9534	37.7510	37.5543	38.1616	37.7510	38.1616	(38)
Heat transfer coeff	97.7559	97.0631	97.2883	96.8435	96.8435	96.6297	96.4216	96.2191	96.0224	96.6297	96.2191	96.6297	(39)
Average = Sum(39)m / 12 =												96.7138	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2171	1.2085	1.2113	1.2057	1.2057	1.2031	1.2005	1.1979	1.1955	1.2031	1.1979	1.2031	(40)
HLP (average)												1.2041	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(80)
East	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(76)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946 (83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5739	33.8135	33.7352	33.8902	33.8902	33.9652	34.0385	34.1101	34.1800	33.9652	34.1101	33.9652	
alpha	3.2383	3.2542	3.2490	3.2593	3.2593	3.2643	3.2692	3.2740	3.2787	3.2643	3.2740	3.2643	
util living area	0.9553	0.9356	0.8847	0.7844	0.6457	0.4615	0.3414	0.3592	0.5864	0.8192	0.9263	0.9612	(86)
MIT	19.4909	19.6937	20.0856	20.5156	20.8055	20.9518	20.9865	20.9844	20.8939	20.5330	19.9733	19.4667	(87)
Th 2	19.9064	19.9132	19.9110	19.9154	19.9154	19.9176	19.9196	19.9216	19.9236	19.9176	19.9216	19.9176	(88)
util rest of house	0.9467	0.9236	0.8634	0.7466	0.5861	0.3824	0.2500	0.2638	0.5058	0.7768	0.9099	0.9535	(89)
MIT 2	17.9470	18.2392	18.7868	19.3686	19.7293	19.8846	19.9140	19.9151	19.8403	19.4107	18.6486	17.9206	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.3338	18.6036	19.1122	19.6559	19.9989	20.1519	20.1826	20.1829	20.1042	19.6918	18.9804	18.3079	(92)

Temperature adjustment -0.1500

adjusted MIT	18.1838	18.4536	18.9622	19.5059	19.8489	20.0019	20.0326	20.0329	19.9542	19.5418	18.8304	18.1579	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9027	0.8411	0.7305	0.5821	0.3888	0.2598	0.2739	0.5083	0.7596	0.8887	0.9364	(94)
Useful gains	667.8843	731.6328	785.0670	773.0067	639.4113	440.2507	280.1375	279.1428	470.6352	606.8006	633.5741	631.9761	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1298.5654	1276.7265	1163.7780	969.0089	711.6957	454.3432	282.7695	282.2028	504.5236	786.7419	1051.7178	1271.4410	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.2267	366.3029	281.7610	141.1215	53.7796	0.0000	0.0000	0.0000	0.0000	133.8763	301.0634	475.7619	(98)

Space heating 2222.8934 (98)
RHI space heating demand 2223 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	100.1422	99.8542	99.5720	98.2462	97.9982	96.8435	96.8435	96.6297	97.2883	97.9982	98.5000	99.0246	(39)
Average = Sum(39)m / 12 =												98.2450	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2468	1.2432	1.2397	1.2232	1.2201	1.2057	1.2057	1.2031	1.2113	1.2201	1.2263	1.2329	(40)
HLP (average)												1.2232	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
								Total per year (kWh/year) = Sum(64)m =				1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7738	32.8683	32.9615	33.4063	33.4908	33.8902	33.8902	33.9652	33.7352	33.4908	33.3202	33.1437	
alpha	3.1849	3.1912	3.1974	3.2271	3.2327	3.2593	3.2593	3.2643	3.2490	3.2327	3.2213	3.2096	
util living area													
	0.9647	0.9440	0.9030	0.8207	0.6966	0.5398	0.4070	0.4484	0.6603	0.8636	0.9459	0.9697	(86)
MIT	19.2923	19.5471	19.9360	20.3916	20.7258	20.9139	20.9741	20.9642	20.8295	20.3745	19.7542	19.2465	(87)
Th 2	19.8828	19.8856	19.8884	19.9015	19.9040	19.9154	19.9154	19.9176	19.9110	19.9040	19.8990	19.8938	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6429	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6467	18.0124	18.5635	19.1961	19.6260	19.8487	19.9022	19.8979	19.7641	19.1931	18.3239	17.5879	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0589	18.3968	18.9073	19.4956	19.9015	20.1155	20.1707	20.1650	20.0310	19.4891	18.6821	18.0034	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9089	18.2468	18.7573	19.3456	19.7515	19.9655	20.0207	20.0150	19.8810	19.3391	18.5321	17.8534	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9129	0.8618	0.7686	0.6348	0.4664	0.3222	0.3606	0.5832	0.8097	0.9138	0.9484	(94)
Useful gains	645.0910	723.6337	777.8124	778.0672	683.6097	492.0424	325.3354	340.6348	504.5708	610.8409	613.9817	615.3978	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1362.8298	1332.7345	1220.4811	1026.2369	789.0279	519.6177	331.2757	349.3201	562.4232	856.4114	1126.0658	1352.0201	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	533.9977	409.3158	329.3455	178.6822	78.4311	0.0000	0.0000	0.0000	0.0000	182.7045	368.7006	548.0470	(98)
Space heating												2629.2243	(98)
Space heating per m2											(98) / (4) =	32.7344	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2905.2202	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	533.9977	409.3158	329.3455	178.6822	78.4311	0.0000	0.0000	0.0000	0.0000	182.7045	368.7006	548.0470	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.0527	452.2826	363.9177	197.4389	86.6642	0.0000	0.0000	0.0000	0.0000	201.8834	407.4039	605.5768	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7197	89.6375	89.4678	89.1048	88.4838	87.3000	87.3000	87.3000	87.3000	89.0930	89.5543	89.7518	(217)
Fuel for water heating, kWh/month													
	185.1460	162.5252	169.0925	149.5348	145.6225	129.0595	121.2740	136.7748	137.7020	155.2247	166.6181	179.7396	(219)
Water heating fuel used												1838.3137	(219)
Annual totals kWh/year													
Space heating fuel - main system												2905.2202	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3951.0230	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2905.2202	3.4800	101.1017	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3137	3.4800	63.9733	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			180.5428	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6051	(257)
SAP value		91.5592	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2905.2202	0.2160	627.5276	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3137	0.2160	397.0758	(264)
Space and water heating			1024.6033	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			613.2901	(272)
CO2 emissions per m2			7.6400	(273)
EI value			93.4423	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3831	0.3558	0.3649	0.3467	0.3467	0.3375	0.3284	0.3193	0.3102	0.3375	0.3193	0.3375	(22b)
Effective ac	0.5734	0.5633	0.5666	0.5601	0.5601	0.5570	0.5539	0.5510	0.5481	0.5570	0.5510	0.5570	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2877	38.5949	38.8201	38.3754	38.3754	38.1616	37.9534	37.7510	37.5543	38.1616	37.7510	38.1616	(38)
Heat transfer coeff	97.7559	97.0631	97.2883	96.8435	96.8435	96.6297	96.4216	96.2191	96.0224	96.6297	96.2191	96.6297	(39)
Average = Sum(39)m / 12 =												96.7138	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2171	1.2085	1.2113	1.2057	1.2057	1.2031	1.2005	1.1979	1.1955	1.2031	1.1979	1.2031	(40)
HLP (average)												1.2041	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(80)
East	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(76)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946 (83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5739	33.8135	33.7352	33.8902	33.8902	33.9652	34.0385	34.1101	34.1800	33.9652	34.1101	33.9652	
alpha	3.2383	3.2542	3.2490	3.2593	3.2593	3.2643	3.2692	3.2740	3.2787	3.2643	3.2740	3.2643	
util living area	0.9553	0.9356	0.8847	0.7844	0.6457	0.4615	0.3414	0.3592	0.5864	0.8192	0.9263	0.9612	(86)
MIT	19.4909	19.6937	20.0856	20.5156	20.8055	20.9518	20.9865	20.9844	20.8939	20.5330	19.9733	19.4667	(87)
Th 2	19.9064	19.9132	19.9110	19.9154	19.9154	19.9176	19.9196	19.9216	19.9236	19.9176	19.9216	19.9176	(88)
util rest of house	0.9467	0.9236	0.8634	0.7466	0.5861	0.3824	0.2500	0.2638	0.5058	0.7768	0.9099	0.9535	(89)
MIT 2	17.9470	18.2392	18.7868	19.3686	19.7293	19.8846	19.9140	19.9151	19.8403	19.4107	18.6486	17.9206	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.3338	18.6036	19.1122	19.6559	19.9989	20.1519	20.1826	20.1829	20.1042	19.6918	18.9804	18.3079	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1838	18.4536	18.9622	19.5059	19.8489	20.0019	20.0326	20.0329	19.9542	19.5418	18.8304	18.1579	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9027	0.8411	0.7305	0.5821	0.3888	0.2598	0.2739	0.5083	0.7596	0.8887	0.9364	(94)
Useful gains	667.8843	731.6328	785.0670	773.0067	639.4113	440.2507	280.1375	279.1428	470.6352	606.8006	633.5741	631.9761	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1298.5654	1276.7265	1163.7780	969.0089	711.6957	454.3432	282.7695	282.2028	504.5236	786.7419	1051.7178	1271.4410	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.2267	366.3029	281.7610	141.1215	53.7796	0.0000	0.0000	0.0000	0.0000	133.8763	301.0634	475.7619	(98)

Space heating 2222.8934 (98)

Space heating per m2 (98) / (4) = 27.6755 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2456.2358	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	469.2267	366.3029	281.7610	141.1215	53.7796	0.0000	0.0000	0.0000	0.0000	133.8763	301.0634	475.7619	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	518.4826	404.7546	311.3381	155.9354	59.4250	0.0000	0.0000	0.0000	0.0000	147.9296	332.6668	525.7037	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6409	89.5658	89.3558	88.9172	88.2185	87.3000	87.3000	87.3000	87.3000	88.8452	89.4139	89.6677	(217)
Fuel for water heating, kWh/month													
	185.3087	162.6553	169.3044	149.8504	146.0604	129.0595	121.2740	136.7748	137.7020	155.6576	166.8797	179.9082	(219)
Water heating fuel used												1840.4351	(219)
Annual totals kWh/year													
Space heating fuel - main system												2456.2358	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3353.7398	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2456.2358	10.2300	251.2729	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.4351	10.2300	188.2765	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	351.0461	36.7200	128.9041	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			196.3052	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2456.2358	0.2160	530.5469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4351	0.2160	397.5340	(264)
Space and water heating			928.0809	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			438.6997	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2456.2358	1.2200	2996.6076	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4351	1.2200	2245.3308	(264)
Space and water heating			5241.9384	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2347.1402	(272)
Primary energy kWh/m2/year			29.2224	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 82	-185 kg (42.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£82	2.31 kg/m²	A 93	A 95
Total Savings	£82	2.31 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£156	£175	-£18
Mains gas	£543	£442	£100
Space heating	£382	£382	£0
Water heating	£188	£107	£82
Lighting	£129	£129	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£196	£114	£82
Total cost of uses	£196	£115	£82
Delivered energy	42 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	100.1422	99.8542	99.5720	98.2462	97.9982	96.8435	96.8435	96.6297	97.2883	97.9982	98.5000	99.0246	(39)
Average = Sum(39)m / 12 =												98.2450	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2468	1.2432	1.2397	1.2232	1.2201	1.2057	1.2057	1.2031	1.2113	1.2201	1.2263	1.2329	(40)
HLP (average)												1.2232	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)
Total heat required for water heating calculated for each month												
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)
Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7738	32.8683	32.9615	33.4063	33.4908	33.8902	33.8902	33.9652	33.7352	33.4908	33.3202	33.1437	
alpha	3.1849	3.1912	3.1974	3.2271	3.2327	3.2593	3.2593	3.2643	3.2490	3.2327	3.2213	3.2096	
util living area													
	0.9647	0.9440	0.9030	0.8207	0.6966	0.5398	0.4070	0.4484	0.6603	0.8636	0.9459	0.9697	(86)
MIT	19.2923	19.5471	19.9360	20.3916	20.7258	20.9139	20.9741	20.9642	20.8295	20.3745	19.7542	19.2465	(87)
Th 2	19.8828	19.8856	19.8884	19.9015	19.9040	19.9154	19.9154	19.9176	19.9110	19.9040	19.8990	19.8938	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6429	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6467	18.0124	18.5635	19.1961	19.6260	19.8487	19.9022	19.8979	19.7641	19.1931	18.3239	17.5879	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0589	18.3968	18.9073	19.4956	19.9015	20.1155	20.1707	20.1650	20.0310	19.4891	18.6821	18.0034	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9089	18.2468	18.7573	19.3456	19.7515	19.9655	20.0207	20.0150	19.8810	19.3391	18.5321	17.8534	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9129	0.8618	0.7686	0.6348	0.4664	0.3222	0.3606	0.5832	0.8097	0.9138	0.9484	(94)
Useful gains	645.0910	723.6337	777.8124	778.0672	683.6097	492.0424	325.3354	340.6348	504.5708	610.8409	613.9817	615.3978	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1362.8298	1332.7345	1220.4811	1026.2369	789.0279	519.6177	331.2757	349.3201	562.4232	856.4114	1126.0658	1352.0201	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	533.9977	409.3158	329.3455	178.6822	78.4311	0.0000	0.0000	0.0000	0.0000	182.7045	368.7006	548.0470	(98)
Space heating												2629.2243	(98)
Space heating per m2											(98) / (4) =	32.7344	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2905.2202	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	533.9977	409.3158	329.3455	178.6822	78.4311	0.0000	0.0000	0.0000	0.0000	182.7045	368.7006	548.0470	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.0527	452.2826	363.9177	197.4389	86.6642	0.0000	0.0000	0.0000	0.0000	201.8834	407.4039	605.5768	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8099	89.8287	89.8454	89.8975	90.0113	87.3000	87.3000	87.3000	87.3000	89.4501	89.6918	89.8269	(217)
Fuel for water heating, kWh/month													
	157.6967	116.6942	90.9297	44.4756	15.1504	0.0000	0.0000	24.9065	50.0868	96.2123	133.9817	156.7791	(219)
Water heating fuel used												886.9131	(219)
Annual totals kWh/year													
Space heating fuel - main system												2905.2202	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3049.6224	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2905.2202	3.4800	101.1017	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9131	3.4800	30.8646	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			154.0290	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5162	(257)
SAP value	92.7988	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2905.2202	0.2160	627.5276	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9131	0.2160	191.5732	(264)
Space and water heating			819.1008	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			433.7376	(272)
CO2 emissions per m2			5.4000	(273)
EI value			95.3622	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3831	0.3558	0.3649	0.3467	0.3467	0.3375	0.3284	0.3193	0.3102	0.3375	0.3193	0.3375	(22b)
Effective ac	0.5734	0.5633	0.5666	0.5601	0.5601	0.5570	0.5539	0.5510	0.5481	0.5570	0.5510	0.5570	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2877	38.5949	38.8201	38.3754	38.3754	38.1616	37.9534	37.7510	37.5543	38.1616	37.7510	38.1616	(38)
Heat transfer coeff	97.7559	97.0631	97.2883	96.8435	96.8435	96.6297	96.4216	96.2191	96.0224	96.6297	96.2191	96.6297	(39)
Average = Sum(39)m / 12 =												96.7138	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2171	1.2085	1.2113	1.2057	1.2057	1.2031	1.2005	1.1979	1.1955	1.2031	1.1979	1.2031	(40)
HLP (average)												1.2041	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3896	(H8)
Utilisation factor												0.5131	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-876.6189	(H17)
Solar input -28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154	(63)	
										Solar input (sum of months) = Sum(63)m =	-876.6189	(63)	
Output from w/h													
137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)	
										Total per year (kWh/year) = Sum(64)m =	771.1322	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(80)
East	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(76)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946	(83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5739	33.8135	33.7352	33.8902	33.8902	33.9652	34.0385	34.1101	34.1800	33.9652	34.1101	33.9652	
alpha	3.2383	3.2542	3.2490	3.2593	3.2593	3.2643	3.2692	3.2740	3.2787	3.2643	3.2740	3.2643	
util living area													
	0.9553	0.9356	0.8847	0.7844	0.6457	0.4615	0.3414	0.3592	0.5864	0.8192	0.9263	0.9612	(86)
MIT	19.4909	19.6937	20.0856	20.5156	20.8055	20.9518	20.9865	20.9844	20.8939	20.5330	19.9733	19.4667	(87)
Th 2	19.9064	19.9132	19.9110	19.9154	19.9154	19.9176	19.9196	19.9216	19.9236	19.9176	19.9216	19.9176	(88)
util rest of house													
	0.9467	0.9236	0.8634	0.7466	0.5861	0.3824	0.2500	0.2638	0.5058	0.7768	0.9099	0.9535	(89)
MIT 2	17.9470	18.2392	18.7868	19.3686	19.7293	19.8846	19.9140	19.9151	19.8403	19.4107	18.6486	17.9206	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3338	18.6036	19.1122	19.6559	19.9989	20.1519	20.1826	20.1829	20.1042	19.6918	18.9804	18.3079	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1838	18.4536	18.9622	19.5059	19.8489	20.0019	20.0326	20.0329	19.9542	19.5418	18.8304	18.1579	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9027	0.8411	0.7305	0.5821	0.3888	0.2598	0.2739	0.5083	0.7596	0.8887	0.9364	(94)
Useful gains	667.8843	731.6328	785.0670	773.0067	639.4113	440.2507	280.1375	279.1428	470.6352	606.8006	633.5741	631.9761	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1298.5654	1276.7265	1163.7780	969.0089	711.6957	454.3432	282.7695	282.2028	504.5236	786.7419	1051.7178	1271.4410	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	469.2267	366.3029	281.7610	141.1215	53.7796	0.0000	0.0000	0.0000	0.0000	133.8763	301.0634	475.7619	(98)
Space heating												2222.8934	(98)
Space heating per m2											(98) / (4) =	27.6755	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2456.2358	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	469.2267	366.3029	281.7610	141.1215	53.7796	0.0000	0.0000	0.0000	0.0000	133.8763	301.0634	475.7619	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	518.4826	404.7546	311.3381	155.9354	59.4250	0.0000	0.0000	0.0000	0.0000	147.9296	332.6668	525.7037	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7543	89.7668	89.7626	89.7882	89.6726	87.3000	87.3000	87.3000	87.3000	89.2556	89.5901	89.7610	(217)
Fuel for water heating, kWh/month													
	153.2127	116.9918	90.6748	43.3725	20.1757	0.0000	0.0000	18.0306	44.7335	92.0751	128.7982	153.5234	(219)
Water heating fuel used												861.5883	(219)
Annual totals kWh/year													
Space heating fuel - main system												2456.2358	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2424.8931	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2456.2358	10.2300	251.2729	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.5883	10.2300	88.1405	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	351.0461	36.7200	128.9041	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			114.5291	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2456.2358	0.2160	530.5469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.5883	0.2160	186.1031	(264)
Space and water heating			716.6500	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			253.2188	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2456.2358	1.2200	2996.6076	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.5883	1.2200	1051.1377	(264)
Space and water heating			4047.7454	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1306.4472	(272)
Primary energy kWh/m2/year			16.2655	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
East	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-316	**Issued on Date**	10/08/2023
Assessment Reference	As Built	**Prop Type Ref**	3S-As-SEMI
Property	1, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	92 A	**DER**	8.95	**TER**	17.01
Environmental	93 A	**% DER<TER**	47.39		
CO_2 Emissions (t/year)	0.56	**DFEE**	43.33	**TFEE**	50.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.69		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 98 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.95 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.53 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 3.29 m², No overhang
Windows facing South: 8.06 m², No overhang
Windows facing West: 7.64 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750	(22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.6716	48.4031	48.1399	46.9037	46.6724	45.5957	45.5957	45.3963	46.0104	46.6724	47.1403	47.6294	(38)
Heat transfer coeff	118.1917	117.9232	117.6600	116.4238	116.1925	115.1158	115.1158	114.9164	115.5306	116.1925	116.6604	117.1496	(39)
Average = Sum(39)m / 12 =												116.4227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2073	1.2045	1.2018	1.1892	1.1868	1.1759	1.1759	1.1738	1.1801	1.1868	1.1916	1.1966	(40)
HLP (average)												1.1892	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
											Total per year (kWh/year) = Sum(64)m =	1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	419.4128	417.2026	402.0617	377.5251	352.4122	328.3539	312.8136	319.1674	331.8472	356.6095	385.0719	406.6105	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	628.9184	784.5339	925.4623	1049.4817	1118.1799	1092.1461	1047.8712	985.1544	907.6095	768.8734	638.0868	584.4689	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2777	32.3512	32.4236	32.7679	32.8331	33.1402	33.1402	33.1977	33.0212	32.8331	32.7014	32.5649	
alpha	3.1518	3.1567	3.1616	3.1845	3.1889	3.2093	3.2093	3.2132	3.2014	3.1889	3.1801	3.1710	
util living area													
	0.9813	0.9630	0.9282	0.8590	0.7481	0.5979	0.4580	0.5003	0.7104	0.8987	0.9681	0.9849	(86)
MIT	19.0385	19.3461	19.7735	20.2630	20.6451	20.8779	20.9612	20.9479	20.7780	20.2477	19.5424	18.9808	(87)
Th 2	19.9142	19.9164	19.9185	19.9286	19.9305	19.9394	19.9394	19.9410	19.9360	19.9305	19.9267	19.9227	(88)
util rest of house													
	0.9776	0.9559	0.9143	0.8314	0.6988	0.5201	0.3574	0.3986	0.6394	0.8726	0.9607	0.9819	(89)
MIT 2	17.3081	17.7529	18.3646	19.0530	19.5579	19.8398	19.9182	19.9105	19.7357	19.0505	18.0481	17.2297	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	17.6417	18.0600	18.6361	19.2862	19.7675	20.0399	20.1193	20.1104	19.9366	19.2813	18.3361	17.5672	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4917	17.9100	18.4861	19.1362	19.6175	19.8899	19.9693	19.9604	19.7866	19.1313	18.1861	17.4172	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9651	0.9373	0.8902	0.8070	0.6825	0.5162	0.3604	0.4005	0.6282	0.8477	0.9435	0.9712	(94)
Useful gains	606.9559	735.3600	823.8731	846.8962	763.2016	563.7589	377.6394	394.5824	570.1758	651.7364	602.0194	567.6132	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1559.1441	1534.1812	1410.2905	1191.7418	919.9529	608.9487	387.8562	409.1517	656.9765	991.2707	1293.3063	1548.3887	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	708.4281	536.8078	436.2945	248.2888	116.6230	0.0000	0.0000	0.0000	0.0000	252.6135	497.7266	729.6969	(98)
Space heating												3526.4792	(98)
Space heating per m2											(98) / (4) =	36.0212	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3896.6621	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	708.4281	536.8078	436.2945	248.2888	116.6230	0.0000	0.0000	0.0000	0.0000	252.6135	497.7266	729.6969	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	782.7934	593.1578	482.0934	274.3522	128.8651	0.0000	0.0000	0.0000	0.0000	279.1310	549.9741	806.2949	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8451	89.7658	89.6182	89.3147	88.7474	87.3000	87.3000	87.3000	87.3000	89.2997	89.7081	89.8753	(217)
Fuel for water heating, kWh/month													
	195.7138	171.7771	178.6284	157.7750	153.4845	136.3341	128.0150	144.5119	145.5334	163.7864	176.0093	189.9738	(219)
Water heating fuel used												1941.5427	(219)
Annual totals kWh/year													
Space heating fuel - main system												3896.6621	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5097.0038	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3896.6621	0.2160	841.6790	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1941.5427	0.2160	419.3732	(264)
Space and water heating			1261.0522	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			876.3689	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.9500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		8.9500	ZC1
Total Floor Area	TFA	97.9000	
Assumed number of occupants	N	2.7192	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3070	ZC2
CO2 emissions from cooking, equation (L16)		1.8821	ZC3
Total CO2 emissions		26.1392	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.1392	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4347	0.4261	0.4176	0.3750	0.3665	0.3239	0.3239	0.3153	0.3409	0.3665	0.3835	0.4006	(22b)
Effective ac	0.5945	0.5908	0.5872	0.5703	0.5672	0.5524	0.5524	0.5497	0.5581	0.5672	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			18.9900	1.3258	25.1761			(27)
GF B&B J150 P/A=0.40			48.9500	0.1300	6.3635			(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.1800	15.2298			(29a)
Plane Ceiling	48.9500		48.9500	0.1300	6.3635			(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.2629			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4967	(36)
Total fabric heat loss					(33) + (36) =		66.7596	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6456	49.3392	49.0390	47.6286	47.3648	46.1364	46.1364	45.9089	46.6096	47.3648	47.8986	48.4566	(38)
Heat transfer coeff	116.4052	116.0989	115.7986	114.3883	114.1244	112.8960	112.8960	112.6686	113.3692	114.1244	114.6582	115.2163	(39)
Average = Sum(39)m / 12 =												114.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1890	1.1859	1.1828	1.1684	1.1657	1.1532	1.1532	1.1509	1.1580	1.1657	1.1712	1.1769	(40)
HLP (average)												1.1684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7192	(42)
Average daily hot water use (litres/day)												98.7814	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)
Energy content (annual)										Total = Sum(45)m =		1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.7398	47.3176	43.8427	45.3041	47.3176	47.7398	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(64)
								Total per year (kWh/year) = Sum(64)m =				2132.6558	(64)
Heat gains from water heating, kWh/month													
	66.3184	58.3671	61.0953	54.0925	52.2806	45.8670	43.6719	48.9467	49.4956	56.5130	60.1107	64.6278	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	89.1377	86.8558	82.1174	75.1285	70.2696	63.7042	58.6987	65.7886	68.7439	75.9583	83.4871	86.8654	(72)
Total internal gains													
	431.5964	429.3914	414.2612	389.1964	363.4209	338.7027	323.1724	330.1854	343.5325	368.8229	397.2683	418.7993	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.6300	0.7000	0.7700	19.7476	(76)
South	8.0600	46.7521	0.6300	0.7000	0.7700	115.1616	(78)
West	7.6400	19.6403	0.6300	0.7000	0.7700	45.8577	(80)

Solar gains	180.7669	316.9430	451.6037	579.7817	660.7244	659.0198	634.2269	574.6309	496.7827	355.7120	218.3079	153.4609	(83)
Total gains	612.3634	746.3344	865.8649	968.9781	1024.1453	997.7225	957.3993	904.8164	840.3152	724.5349	615.5762	572.2601	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.4047	58.5588	58.7107	59.4345	59.5719	60.2201	60.2201	60.3417	59.9688	59.5719	59.2946	59.0074	
alpha	4.8936	4.9039	4.9140	4.9623	4.9715	5.0147	5.0147	5.0228	4.9979	4.9715	4.9530	4.9338	
util living area													
	0.9976	0.9933	0.9809	0.9420	0.8470	0.6780	0.5094	0.5574	0.8021	0.9647	0.9945	0.9983	(86)
MIT	19.7302	19.9251	20.2088	20.5493	20.8146	20.9558	20.9913	20.9866	20.8963	20.5332	20.0620	19.6975	(87)
Th 2	19.9288	19.9313	19.9338	19.9453	19.9475	19.9576	19.9576	19.9595	19.9537	19.9475	19.9431	19.9385	(88)
util rest of house													
	0.9968	0.9911	0.9743	0.9214	0.7956	0.5858	0.3936	0.4391	0.7223	0.9480	0.9922	0.9977	(89)
MIT 2	18.2422	18.5278	18.9393	19.4263	19.7703	19.9290	19.9545	19.9542	19.8743	19.4152	18.7369	18.2014	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	18.5290	18.7971	19.1840	19.6428	19.9716	20.1269	20.1544	20.1532	20.0713	19.6307	18.9923	18.4898	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5290	18.7971	19.1840	19.6428	19.9716	20.1269	20.1544	20.1532	20.0713	19.6307	18.9923	18.4898	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9876	0.9680	0.9141	0.7969	0.6017	0.4160	0.4618	0.7324	0.9413	0.9892	0.9964	(94)
Useful gains	609.3914	737.0888	838.1673	885.7664	816.1256	600.3588	398.2823	417.8813	615.4694	682.0294	608.9445	570.2250	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1656.3348	1613.4369	1468.7879	1228.8455	943.9897	623.9702	401.2749	422.8680	676.9588	1030.6222	1363.5537	1646.4166	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	778.9259	588.9059	469.1818	247.0169	95.1309	0.0000	0.0000	0.0000	0.0000	259.3530	543.3186	800.6865	(98)
Space heating												3782.5195	(98)
Space heating per m2											(98) / (4) =	38.6366	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4049.8068	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	778.9259	588.9059	469.1818	247.0169	95.1309	0.0000	0.0000	0.0000	0.0000	259.3530	543.3186	800.6865	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	833.9678	630.5202	502.3359	264.4721	101.8532	0.0000	0.0000	0.0000	0.0000	277.6799	581.7116	857.2661	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0303	87.7407	87.1650	85.9254	83.6671	80.3000	80.3000	80.3000	80.3000	85.9341	87.5146	88.1230	(217)
Fuel for water heating, kWh/month													
	240.9373	213.0831	225.3075	203.1175	201.9617	185.3351	177.5652	197.9436	200.1296	212.4975	220.5578	234.9141	(219)
Water heating fuel used												2513.3499	(219)
Annual totals kWh/year													
Space heating fuel - main system												4049.8068	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Total delivered energy for all uses												7040.5128	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4049.8068	0.2160	874.7583	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2513.3499	0.2160	542.8836	(264)
Space and water heating			1417.6418	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Total CO2, kg/m2/year			1665.3897	(272)
Emissions per m2 for space and water heating			14.4805	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1330	(272b)
Emissions per m2 for pumps and fans			0.3976	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4805 * 1.00) + 2.1330 + 0.3976, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750	(22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.6716	48.4031	48.1399	46.9037	46.6724	45.5957	45.5957	45.3963	46.0104	46.6724	47.1403	47.6294	(38)
Heat transfer coeff	118.1917	117.9232	117.6600	116.4238	116.1925	115.1158	115.1158	114.9164	115.5306	116.1925	116.6604	117.1496	(39)
Average = Sum(39)m / 12 =												116.4227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2073	1.2045	1.2018	1.1892	1.1868	1.1759	1.1759	1.1738	1.1801	1.1868	1.1916	1.1966	(40)
HLP (average)												1.1892	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

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Energy content (annual)												Total = Sum(45)m =	1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2420	29.9483	30.9040	26.9428	25.8523	22.3085	20.6721	23.7216	24.0049	27.9754	30.5373	33.1616	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	46.0242	44.5659	41.5376	37.4206	34.7477	30.9841	27.7851	31.8839	33.3401	37.6013	42.4130	44.5720	(72)
Total internal gains													
	385.4830	384.1015	370.6814	348.4885	324.8989	302.9826	289.2588	293.2807	305.1287	327.4659	353.1941	373.5059	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	594.9886	751.4328	894.0820	1020.4451	1090.6667	1066.7748	1024.3164	959.2677	880.8910	739.7298	606.2091	551.3643	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2777	32.3512	32.4236	32.7679	32.8331	33.1402	33.1402	33.1977	33.0212	32.8331	32.7014	32.5649	
alpha	3.1518	3.1567	3.1616	3.1845	3.1889	3.2093	3.2093	3.2132	3.2014	3.1889	3.1801	3.1710	
util living area													
	0.9839	0.9669	0.9338	0.8667	0.7577	0.6081	0.4670	0.5114	0.7226	0.9070	0.9721	0.9872	(86)
MIT	18.9926	19.3042	19.7385	20.2382	20.6305	20.8716	20.9589	20.9445	20.7661	20.2185	19.5011	18.9354	(87)
Th 2	19.9142	19.9164	19.9185	19.9286	19.9305	19.9394	19.9394	19.9410	19.9360	19.9305	19.9267	19.9227	(88)
util rest of house													
	0.9807	0.9604	0.9207	0.8401	0.7091	0.5300	0.3650	0.4082	0.6523	0.8824	0.9656	0.9846	(89)
MIT 2	18.0896	18.3984	18.8244	19.3086	19.6645	19.8676	19.9240	19.9187	19.7909	19.3033	18.6038	18.0390	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	18.2637	18.5730	19.0006	19.4878	19.8507	20.0611	20.1235	20.1164	19.9788	19.4797	18.7768	18.2118	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2637	18.5730	19.0006	19.4878	19.8507	20.0611	20.1235	20.1164	19.9788	19.4797	18.7768	18.2118	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9500	0.9070	0.8274	0.7051	0.5396	0.3835	0.4262	0.6555	0.8697	0.9562	0.9789	(94)
Useful gains	579.4949	713.8256	810.9427	844.2962	768.9952	575.6320	392.8226	408.8764	577.4081	643.3522	579.6825	539.7261	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1650.3888	1612.3654	1470.8182	1232.6690	947.0515	628.6594	405.6120	427.0735	679.1862	1031.7543	1362.2188	1641.4745	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	796.7450	603.8187	490.9473	279.6284	132.4739	0.0000	0.0000	0.0000	0.0000	288.9711	563.4261	819.7008	(98)
Space heating												3975.7113	(98)
Space heating per m2											(98) / (4) =	40.6099	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1082.0889	851.8572	873.3650	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8392	0.8930	0.8725	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	908.0350	760.7206	762.0468	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1350.8299	1298.9742	1224.7928	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	318.8123	400.4607	344.2830	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1063.5560	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	79.7031	100.1152	86.0707	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												265.8890	(107)
Space cooling per m2												2.7159	(108)
Energy for space heating												40.6099	(99)
Energy for space cooling												2.7159	(108)
Total												43.3258	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4347	0.4261	0.4176	0.3750	0.3665	0.3239	0.3239	0.3153	0.3409	0.3665	0.3835	0.4006	(22b)
Effective ac	0.5945	0.5908	0.5872	0.5703	0.5672	0.5524	0.5524	0.5497	0.5581	0.5672	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			18.9900	1.3258	25.1761			(27)
GF B&B J150 P/A=0.40			48.9500	0.1300	6.3635			(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.1800	15.2298			(29a)
Plane Ceiling	48.9500		48.9500	0.1300	6.3635			(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.2629			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4967	(36)
Total fabric heat loss (33) + (36) =	66.7596	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6456	49.3392	49.0390	47.6286	47.3648	46.1364	46.1364	45.9089	46.6096	47.3648	47.8986	48.4566	(38)
Heat transfer coeff	116.4052	116.0989	115.7986	114.3883	114.1244	112.8960	112.8960	112.6686	113.3692	114.1244	114.6582	115.2163	(39)
Average = Sum(39)m / 12 =												114.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1890	1.1859	1.1828	1.1684	1.1657	1.1532	1.1532	1.1509	1.1580	1.1657	1.1712	1.1769	(40)
HLP (average)												1.1684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)
Energy content (annual)										Total = Sum(45)m =		1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2420	29.9483	30.9040	26.9428	25.8523	22.3085	20.6721	23.7216	24.0049	27.9754	30.5373	33.1616	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	46.0242	44.5659	41.5376	37.4206	34.7477	30.9841	27.7851	31.8839	33.3401	37.6013	42.4130	44.5720	(72)
Total internal gains													
	385.4830	384.1015	370.6814	348.4885	324.8989	302.9826	289.2588	293.2807	305.1287	327.4659	353.1941	373.5059	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.6300	0.7000	0.7700	19.7476	(76)
South	8.0600	46.7521	0.6300	0.7000	0.7700	115.1616	(78)
West	7.6400	19.6403	0.6300	0.7000	0.7700	45.8577	(80)

Solar gains	180.7669	316.9430	451.6037	579.7817	660.7244	659.0198	634.2269	574.6309	496.7827	355.7120	218.3079	153.4609	(83)
Total gains	566.2499	701.0445	822.2851	928.2702	985.6233	962.0024	923.4857	867.9116	801.9115	683.1779	571.5020	526.9668	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.4047	58.5588	58.7107	59.4345	59.5719	60.2201	60.2201	60.3417	59.9688	59.5719	59.2946	59.0074	
alpha	4.8936	4.9039	4.9140	4.9623	4.9715	5.0147	5.0147	5.0228	4.9979	4.9715	4.9530	4.9338	
util living area													
	0.9983	0.9949	0.9845	0.9500	0.8618	0.6969	0.5265	0.5783	0.8228	0.9717	0.9960	0.9988	(86)
MIT	19.6868	19.8833	20.1708	20.5198	20.7972	20.9500	20.9899	20.9843	20.8827	20.4997	20.0209	19.6546	(87)
Th 2	19.9288	19.9313	19.9338	19.9453	19.9475	19.9576	19.9576	19.9595	19.9537	19.9475	19.9431	19.9385	(88)
util rest of house													
	0.9977	0.9931	0.9790	0.9317	0.8128	0.6045	0.4077	0.4569	0.7459	0.9578	0.9943	0.9984	(89)
MIT 2	18.7340	18.9316	19.2180	19.5642	19.8135	19.9353	19.9552	19.9552	19.8910	19.5530	19.0790	18.7097	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	18.9177	19.1151	19.4016	19.7484	20.0031	20.1309	20.1546	20.1535	20.0822	19.7355	19.2605	18.8919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9177	19.1151	19.4016	19.7484	20.0031	20.1309	20.1546	20.1535	20.0822	19.7355	19.2605	18.8919	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9913	0.9754	0.9275	0.8157	0.6209	0.4308	0.4804	0.7566	0.9542	0.9928	0.9978	(94)
Useful gains	564.5139	694.9502	802.0355	860.9633	804.0101	597.3133	397.8053	416.9688	606.7635	651.8713	567.4130	525.8193	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1701.5709	1650.3522	1493.9899	1240.9319	947.5849	624.4111	401.3020	422.9066	678.1926	1042.5814	1394.3040	1692.7413	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	845.9704	642.0301	514.8141	273.5774	106.8197	0.0000	0.0000	0.0000	0.0000	290.6883	595.3616	868.1899	(98)
Space heating												4137.4514	(98)
Space heating per m2											(98) / (4) =	42.2620	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1061.2228	835.4307	856.2811	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8883	0.9411	0.9233	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	942.7020	786.2305	790.5936	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1228.3687	1181.1201	1118.0130	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	205.6800	293.7979	243.6000	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												743.0779	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	51.4200	73.4495	60.9000	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												185.7695 (107)
Space cooling per m2												1.8975 (108)
Energy for space heating												42.2620 (99)
Energy for space cooling												1.8975 (108)
Total												44.1596 (109)
Target Fabric Energy Efficiency (TFEE)												50.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3351	0.3112	0.3192	0.3032	0.3032	0.2952	0.2872	0.2793	0.2713	0.2952	0.2793	0.2952	(22b)
Effective ac	0.5562	0.5484	0.5509	0.5460	0.5460	0.5436	0.5413	0.5390	0.5368	0.5436	0.5390	0.5436	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.4464	45.8004	46.0104	45.5957	45.5957	45.3963	45.2022	45.0135	44.8300	45.3963	45.0135	45.3963	(38)
Heat transfer coeff	115.9666	115.3205	115.5306	115.1158	115.1158	114.9164	114.7224	114.5336	114.3502	114.9164	114.5336	114.9164	(39)
Average = Sum(39)m / 12 =												114.9949	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1845	1.1779	1.1801	1.1759	1.1759	1.1738	1.1718	1.1699	1.1680	1.1738	1.1699	1.1738	(40)
HLP (average)												1.1746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851 (61)

Total heat required for water heating calculated for each month

	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395 (64)

Total per year (kWh/year) = Sum(64)m = 1726.1309 (64)
RHI water heating demand 1726 (64)
Heat gains from water heating, kWh/month

	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687 (71)

Water heating gains (Table 5)

	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766 (72)
Total internal gains	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	25.1925	0.4600	0.0000	0.7700	29.3573	(76)
South	8.0600	56.7559	0.4600	0.0000	0.7700	162.0296	(78)
West	4.3100	25.1925	0.4600	0.0000	0.7700	38.4590	(80)
West	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(80)

Solar gains	259.5601	387.3457	557.0341	721.8866	784.8346	852.0101	812.8196	752.1309	647.8712	469.1467	312.4350	216.6238	(83)
Total gains	882.3346	1005.3815	1151.0035	1278.3886	1302.7523	1335.4671	1276.1904	1224.3839	1141.7297	1000.6982	885.9203	822.0500	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8971	33.0814	33.0212	33.1402	33.1402	33.1977	33.2539	33.3087	33.3621	33.1977	33.3087	33.1977	
alpha	3.1931	3.2054	3.2014	3.2093	3.2093	3.2132	3.2169	3.2206	3.2241	3.2132	3.2206	3.2132	
util living area	0.9497	0.9263	0.8724	0.7756	0.6445	0.4638	0.3427	0.3557	0.5694	0.7984	0.9158	0.9569	(86)
MIT	19.5027	19.7185	20.1066	20.5153	20.7976	20.9480	20.9853	20.9837	20.8973	20.5561	19.9934	19.4649	(87)
Th 2	19.9324	19.9377	19.9360	19.9394	19.9394	19.9410	19.9426	19.9442	19.9457	19.9410	19.9442	19.9410	(88)
util rest of house	0.9404	0.9134	0.8505	0.7384	0.5867	0.3865	0.2532	0.2633	0.4919	0.7552	0.8984	0.9488	(89)
MIT 2	17.9858	18.2945	18.8359	19.3886	19.7426	19.9044	19.9361	19.9369	19.8638	19.4585	18.6955	17.9384	(90)

Living area fraction fLA = Living area / (4) = 0.1927 (91)

MIT	18.2782	18.5689	19.0808	19.6058	19.9460	20.1055	20.1384	20.1387	20.0630	19.6700	18.9457	18.2326	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1282	18.4189	18.9308	19.4558	19.7960	19.9555	19.9884	19.9887	19.9130	19.5200	18.7957	18.0826	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9194	0.8897	0.8256	0.7192	0.5782	0.3876	0.2571	0.2673	0.4893	0.7353	0.8741	0.9293	(94)
Useful gains	811.2431	894.4865	950.2713	919.4756	753.2961	517.6675	328.1426	327.2677	558.6489	735.8524	774.4022	763.9308	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1534.0274	1512.8821	1378.3750	1146.0674	839.8823	534.9989	331.3587	330.8516	596.1029	933.1263	1247.9246	1503.4067	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	537.7515	415.5619	318.5092	163.1461	64.4202	0.0000	0.0000	0.0000	0.0000	146.7718	340.9361	550.1701	(98)

Space heating 2537.2668 (98)
RHI space heating demand 2537 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750	(22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.6716	48.4031	48.1399	46.9037	46.6724	45.5957	45.5957	45.3963	46.0104	46.6724	47.1403	47.6294	(38)
Heat transfer coeff	118.1917	117.9232	117.6600	116.4238	116.1925	115.1158	115.1158	114.9164	115.5306	116.1925	116.6604	117.1496	(39)
Average = Sum(39)m / 12 =												116.4227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2073	1.2045	1.2018	1.1892	1.1868	1.1759	1.1759	1.1738	1.1801	1.1868	1.1916	1.1966	(40)
HLP (average)												1.1892	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
										Total per year (kWh/year) = Sum(64)m =		1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	832.2801	985.3671	1117.3700	1228.4586	1283.6854	1247.2493	1198.4284	1138.2401	1069.6207	943.8154	826.5003	783.2846	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2777	32.3512	32.4236	32.7679	32.8331	33.1402	33.1402	33.1977	33.0212	32.8331	32.7014	32.5649	
alpha	3.1518	3.1567	3.1616	3.1845	3.1889	3.2093	3.2093	3.2132	3.2014	3.1889	3.1801	3.1710	
util living area													
	0.9609	0.9351	0.8907	0.8103	0.6922	0.5406	0.4068	0.4424	0.6408	0.8456	0.9388	0.9669	(86)
MIT	19.3025	19.5861	19.9707	20.3994	20.7207	20.9089	20.9724	20.9634	20.8373	20.4034	19.7721	19.2443	(87)
Th 2	19.9142	19.9164	19.9185	19.9286	19.9305	19.9394	19.9394	19.9410	19.9360	19.9305	19.9267	19.9227	(88)
util rest of house													
	0.9537	0.9236	0.8715	0.7776	0.6401	0.4656	0.3150	0.3490	0.5682	0.8111	0.9260	0.9607	(89)
MIT 2	17.6870	18.0924	18.6355	19.2289	19.6439	19.8670	19.9247	19.9202	19.7942	19.2521	18.3720	17.6090	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	17.9984	18.3803	18.8928	19.4545	19.8515	20.0678	20.1267	20.1213	19.9953	19.4740	18.6419	17.9242	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8484	18.2303	18.7428	19.3045	19.7015	19.9178	19.9767	19.9713	19.8453	19.3240	18.4919	17.7742	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9346	0.9003	0.8460	0.7557	0.6279	0.4640	0.3184	0.3517	0.5615	0.7877	0.9032	0.9433	(94)
Useful gains	777.8733	887.0921	945.3067	928.2925	806.0648	578.7382	381.5658	400.3681	600.5719	743.4478	746.5133	738.8859	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1601.3044	1571.9497	1440.4928	1211.3361	929.7088	612.1619	388.7079	410.4012	663.7530	1013.6621	1328.9814	1590.2086	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	612.6328	460.2243	368.4185	203.7914	91.9911	0.0000	0.0000	0.0000	0.0000	201.0394	419.3770	633.3841	(98)
Space heating												2990.8587	(98)
Space heating per m2											(98) / (4) =	30.5501	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3304.8162	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	612.6328	460.2243	368.4185	203.7914	91.9911	0.0000	0.0000	0.0000	0.0000	201.0394	419.3770	633.3841	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	676.9423	508.5351	407.0922	225.1839	101.6477	0.0000	0.0000	0.0000	0.0000	222.1430	463.4000	699.8719	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7662	89.6751	89.5062	89.1639	88.5623	87.3000	87.3000	87.3000	87.3000	89.1242	89.6017	89.8011	(217)
Fuel for water heating, kWh/month													
	195.8858	171.9508	178.8519	158.0418	153.8053	136.3341	128.0150	144.5119	145.5334	164.1090	176.2183	190.1308	(219)
Water heating fuel used												1943.3882	(219)
Annual totals kWh/year													
Space heating fuel - main system												3304.8162	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4507.0035	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3304.8162	3.4800	115.0076	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1943.3882	3.4800	67.6299	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	402.3561	13.1900	53.0708	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			204.8731	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6021	(257)
SAP value		91.6001	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3304.8162	0.2160	713.8403	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1943.3882	0.2160	419.7719	(264)
Space and water heating			1133.6122	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			748.9289	(272)
CO2 emissions per m2			7.6500	(273)
EI value			92.9772	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3351	0.3112	0.3192	0.3032	0.3032	0.2952	0.2872	0.2793	0.2713	0.2952	0.2793	0.2952	(22b)
Effective ac	0.5562	0.5484	0.5509	0.5460	0.5460	0.5436	0.5413	0.5390	0.5368	0.5436	0.5390	0.5436	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.4464	45.8004	46.0104	45.5957	45.5957	45.3963	45.2022	45.0135	44.8300	45.3963	45.0135	45.3963	(38)
Heat transfer coeff	115.9666	115.3205	115.5306	115.1158	115.1158	114.9164	114.7224	114.5336	114.3502	114.9164	114.5336	114.9164	(39)
Average = Sum(39)m / 12 =												114.9949	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1845	1.1779	1.1801	1.1759	1.1759	1.1738	1.1718	1.1699	1.1680	1.1738	1.1699	1.1738	(40)
HLP (average)												1.1746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
								Total per year (kWh/year) = Sum(64)m =				1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	25.1925	0.4600	0.0000	0.7700	29.3573	(76)
South	8.0600	56.7559	0.4600	0.0000	0.7700	162.0296	(78)
West	4.3100	25.1925	0.4600	0.0000	0.7700	38.4590	(80)
West	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(80)

Solar gains	259.5601	387.3457	557.0341	721.8866	784.8346	852.0101	812.8196	752.1309	647.8712	469.1467	312.4350	216.6238	(83)
Total gains	882.3346	1005.3815	1151.0035	1278.3886	1302.7523	1335.4671	1276.1904	1224.3839	1141.7297	1000.6982	885.9203	822.0500	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8971	33.0814	33.0212	33.1402	33.1402	33.1977	33.2539	33.3087	33.3621	33.1977	33.3087	33.1977	
alpha	3.1931	3.2054	3.2014	3.2093	3.2093	3.2132	3.2169	3.2206	3.2241	3.2132	3.2206	3.2132	
util living area													
	0.9497	0.9263	0.8724	0.7756	0.6445	0.4638	0.3427	0.3557	0.5694	0.7984	0.9158	0.9569	(86)
MIT	19.5027	19.7185	20.1066	20.5153	20.7976	20.9480	20.9853	20.9837	20.8973	20.5561	19.9934	19.4649	(87)
Th 2	19.9324	19.9377	19.9360	19.9394	19.9394	19.9410	19.9426	19.9442	19.9457	19.9410	19.9442	19.9410	(88)
util rest of house													
	0.9404	0.9134	0.8505	0.7384	0.5867	0.3865	0.2532	0.2633	0.4919	0.7552	0.8984	0.9488	(89)
MIT 2	17.9858	18.2945	18.8359	19.3886	19.7426	19.9044	19.9361	19.9369	19.8638	19.4585	18.6955	17.9384	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	18.2782	18.5689	19.0808	19.6058	19.9460	20.1055	20.1384	20.1387	20.0630	19.6700	18.9457	18.2326	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1282	18.4189	18.9308	19.4558	19.7960	19.9555	19.9884	19.9887	19.9130	19.5200	18.7957	18.0826	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9194	0.8897	0.8256	0.7192	0.5782	0.3876	0.2571	0.2673	0.4893	0.7353	0.8741	0.9293	(94)
Useful gains	811.2431	894.4865	950.2713	919.4756	753.2961	517.6675	328.1426	327.2677	558.6489	735.8524	774.4022	763.9308	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1534.0274	1512.8821	1378.3750	1146.0674	839.8823	534.9989	331.3587	330.8516	596.1029	933.1263	1247.9246	1503.4067	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	537.7515	415.5619	318.5092	163.1461	64.4202	0.0000	0.0000	0.0000	0.0000	146.7718	340.9361	550.1701	(98)
Space heating												2537.2668	(98)
Space heating per m2											(98) / (4) =	25.9169	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2803.6097	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	537.7515	415.5619	318.5092	163.1461	64.4202	0.0000	0.0000	0.0000	0.0000	146.7718	340.9361	550.1701	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	594.2006	459.1844	351.9438	180.2719	71.1825	0.0000	0.0000	0.0000	0.0000	162.1787	376.7250	607.9227	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6899	89.6110	89.4038	88.9883	88.3025	87.3000	87.3000	87.3000	87.3000	88.8740	89.4620	89.7211	(217)
Fuel for water heating, kWh/month													
	196.0525	172.0737	179.0567	158.3537	154.2579	136.3341	128.0150	144.5119	145.5334	164.5710	176.4934	190.3003	(219)
Water heating fuel used												1945.5536	(219)
Annual totals kWh/year													
Space heating fuel - main system												2803.6097	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3857.5423	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2803.6097	10.2300	286.8093	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1945.5536	10.2300	199.0301	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	402.3561	36.7200	147.7452	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			261.4362	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2803.6097	0.2160	605.5797	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1945.5536	0.2160	420.2396	(264)
Space and water heating			1025.8193	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			563.0680	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2803.6097	1.2200	3420.4038	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1945.5536	1.2200	2373.5754	(264)
Space and water heating			5793.9792	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	402.3561	3.0700	1235.2333	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3056.7028	(272)
Primary energy kWh/m2/year			31.2227	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (34.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.97 kg/m²	A 93	A 95
Total Savings	£85	1.97 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£175	£194	-£18
Mains gas	£589	£485	£104
Space heating	£417	£417	£0
Water heating	£199	£114	£85
Lighting	£148	£148	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£261	£176	£86
Total cost of uses	£261	£176	£85
Delivered energy	39 kWh/m²	30 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	31 kWh/m²	20 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500	(1b)	x 2.5400	(2b) =	124.3330	(1b) - (3b)
First floor	48.9500	(1c)	x 2.6300	(2c) =	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750	(22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.6716	48.4031	48.1399	46.9037	46.6724	45.5957	45.5957	45.3963	46.0104	46.6724	47.1403	47.6294	(38)
Heat transfer coeff	118.1917	117.9232	117.6600	116.4238	116.1925	115.1158	115.1158	114.9164	115.5306	116.1925	116.6604	117.1496	(39)
Average = Sum(39)m / 12 =												116.4227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2073	1.2045	1.2018	1.1892	1.1868	1.1759	1.1759	1.1738	1.1801	1.1868	1.1916	1.1966	(40)
HLP (average)												1.1892	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1669	(H8)
Utilisation factor												0.5756	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.7814	(H14)
Volume ratio Veff/V												0.7593	(H15)
Solar storage volume factor												0.9449	(H16)
Solar input												-867.2757	(H17)
Solar input	-25.1493	-41.9669	-71.4744	-95.7898	-118.3402	-116.3473	-114.8097	-100.3098	-78.5627	-53.6491	-29.8307	-21.0456	(63)
										Solar input (sum of months) = Sum(63)m =		-867.2757	(63)
Output from w/h													
	150.6900	112.2301	88.6092	45.1264	17.8733	2.6724	0.0000	25.8491	48.4879	92.6117	128.0639	149.6939	(64)
										Total per year (kWh/year) = Sum(64)m =		861.9079	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	832.2801	985.3671	1117.3700	1228.4586	1283.6854	1247.2493	1198.4284	1138.2401	1069.6207	943.8154	826.5003	783.2846	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.2777	32.3512	32.4236	32.7679	32.8331	33.1402	33.1402	33.1977	33.0212	32.8331	32.7014	32.5649	
alpha	3.1518	3.1567	3.1616	3.1845	3.1889	3.2093	3.2093	3.2132	3.2014	3.1889	3.1801	3.1710	
util living area													
	0.9609	0.9351	0.8907	0.8103	0.6922	0.5406	0.4068	0.4424	0.6408	0.8456	0.9388	0.9669	(86)
MIT	19.3025	19.5861	19.9707	20.3994	20.7207	20.9089	20.9724	20.9634	20.8373	20.4034	19.7721	19.2443	(87)
Th 2	19.9142	19.9164	19.9185	19.9286	19.9305	19.9394	19.9394	19.9410	19.9360	19.9305	19.9267	19.9227	(88)
util rest of house													
	0.9537	0.9236	0.8715	0.7776	0.6401	0.4656	0.3150	0.3490	0.5682	0.8111	0.9260	0.9607	(89)
MIT 2	17.6870	18.0924	18.6355	19.2289	19.6439	19.8670	19.9247	19.9202	19.7942	19.2521	18.3720	17.6090	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	17.9984	18.3803	18.8928	19.4545	19.8515	20.0678	20.1267	20.1213	19.9953	19.4740	18.6419	17.9242	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8484	18.2303	18.7428	19.3045	19.7015	19.9178	19.9767	19.9713	19.8453	19.3240	18.4919	17.7742	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9346	0.9003	0.8460	0.7557	0.6279	0.4640	0.3184	0.3517	0.5615	0.7877	0.9032	0.9433	(94)
Useful gains	777.8733	887.0921	945.3067	928.2925	806.0648	578.7382	381.5658	400.3681	600.5719	743.4478	746.5133	738.8859	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1601.3044	1571.9497	1440.4928	1211.3361	929.7088	612.1619	388.7079	410.4012	663.7530	1013.6621	1328.9814	1590.2086	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	612.6328	460.2243	368.4185	203.7914	91.9911	0.0000	0.0000	0.0000	0.0000	201.0394	419.3770	633.3841	(98)
Space heating												2990.8587	(98)
Space heating per m2											(98) / (4) =	30.5501	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3304.8162	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	612.6328	460.2243	368.4185	203.7914	91.9911	0.0000	0.0000	0.0000	0.0000	201.0394	419.3770	633.3841	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	676.9423	508.5351	407.0922	225.1839	101.6477	0.0000	0.0000	0.0000	0.0000	222.1430	463.4000	699.8719	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	150.6900	112.2301	88.6092	45.1264	17.8733	2.6724	0.0000	25.8491	48.4879	92.6117	128.0639	149.6939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8498	89.8543	89.8614	89.9026	89.9635	87.3000	87.3000	87.3000	87.3000	89.4657	89.7306	89.8703	(217)
Fuel for water heating, kWh/month													
	167.7132	124.9024	98.6065	50.1948	19.8673	3.0612	0.0000	29.6095	55.5417	103.5164	142.7205	166.5666	(219)
Water heating fuel used												962.3000	(219)
Annual totals kWh/year													
Space heating fuel - main system												3304.8162	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3575.9153	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3304.8162	3.4800	115.0076	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.3000	3.4800	33.4880	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	402.3561	13.1900	53.0708	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			177.3262	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5212	(257)
SAP value	92.7295	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3304.8162	0.2160	713.8403	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.3000	0.2160	207.8568	(264)
Space and water heating			921.6971	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			562.9638	(272)
CO2 emissions per m2			5.7500	(273)
EI value			94.7210	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		4.5300	
Infiltration rate		0.3450	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3192	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3351	0.3112	0.3192	0.3032	0.3032	0.2952	0.2872	0.2793	0.2713	0.2952	0.2793	0.2952	(22b)
Effective ac	0.5562	0.5484	0.5509	0.5460	0.5460	0.5436	0.5413	0.5390	0.5368	0.5436	0.5390	0.5436	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.4464	45.8004	46.0104	45.5957	45.5957	45.3963	45.2022	45.0135	44.8300	45.3963	45.0135	45.3963	(38)
Heat transfer coeff	115.9666	115.3205	115.5306	115.1158	115.1158	114.9164	114.7224	114.5336	114.3502	114.9164	114.5336	114.9164	(39)
Average = Sum(39)m / 12 =												114.9949	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1845	1.1779	1.1801	1.1759	1.1759	1.1738	1.1718	1.1699	1.1680	1.1738	1.1699	1.1738	(40)
HLP (average)												1.1746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)	
Total heat required for water heating calculated for each month													
175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3059	(H8)
Utilisation factor												0.5350	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.7814	(H14)
Volume ratio Veff/V												0.7593	(H15)
Solar storage volume factor												0.9449	(H16)
Solar input												-902.2341	(H17)
Solar input -29.4331	-41.8519	-71.9334	-97.0548	-113.9968	-121.7665	-119.2058	-106.6928	-83.5331	-57.7519	-34.8116	-24.2025	(63)	
									Solar input (sum of months) = Sum(63)m =		-902.2341	(63)	
Output from w/h													
146.4062	112.3451	88.1502	43.8614	22.2168	0.0000	0.0000	19.4661	43.5176	88.5089	123.0830	146.5370	(64)	
									Total per year (kWh/year) = Sum(64)m =		834.0923	(64)	
Heat gains from water heating, kWh/month													
57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	25.1925	0.4600	0.0000	0.7700	29.3573	(76)
South	8.0600	56.7559	0.4600	0.0000	0.7700	162.0296	(78)
West	4.3100	25.1925	0.4600	0.0000	0.7700	38.4590	(80)
West	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(80)

Solar gains	259.5601	387.3457	557.0341	721.8866	784.8346	852.0101	812.8196	752.1309	647.8712	469.1467	312.4350	216.6238	(83)
Total gains	882.3346	1005.3815	1151.0035	1278.3886	1302.7523	1335.4671	1276.1904	1224.3839	1141.7297	1000.6982	885.9203	822.0500	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8971	33.0814	33.0212	33.1402	33.1402	33.1977	33.2539	33.3087	33.3621	33.1977	33.3087	33.1977	
alpha	3.1931	3.2054	3.2014	3.2093	3.2093	3.2132	3.2169	3.2206	3.2241	3.2132	3.2206	3.2132	
util living area													
	0.9497	0.9263	0.8724	0.7756	0.6445	0.4638	0.3427	0.3557	0.5694	0.7984	0.9158	0.9569	(86)
MIT	19.5027	19.7185	20.1066	20.5153	20.7976	20.9480	20.9853	20.9837	20.8973	20.5561	19.9934	19.4649	(87)
Th 2	19.9324	19.9377	19.9360	19.9394	19.9394	19.9410	19.9426	19.9442	19.9457	19.9410	19.9442	19.9410	(88)
util rest of house													
	0.9404	0.9134	0.8505	0.7384	0.5867	0.3865	0.2532	0.2633	0.4919	0.7552	0.8984	0.9488	(89)
MIT 2	17.9858	18.2945	18.8359	19.3886	19.7426	19.9044	19.9361	19.9369	19.8638	19.4585	18.6955	17.9384	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	18.2782	18.5689	19.0808	19.6058	19.9460	20.1055	20.1384	20.1387	20.0630	19.6700	18.9457	18.2326	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1282	18.4189	18.9308	19.4558	19.7960	19.9555	19.9884	19.9887	19.9130	19.5200	18.7957	18.0826	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9194	0.8897	0.8256	0.7192	0.5782	0.3876	0.2571	0.2673	0.4893	0.7353	0.8741	0.9293	(94)
Useful gains	811.2431	894.4865	950.2713	919.4756	753.2961	517.6675	328.1426	327.2677	558.6489	735.8524	774.4022	763.9308	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1534.0274	1512.8821	1378.3750	1146.0674	839.8823	534.9989	331.3587	330.8516	596.1029	933.1263	1247.9246	1503.4067	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	537.7515	415.5619	318.5092	163.1461	64.4202	0.0000	0.0000	0.0000	0.0000	146.7718	340.9361	550.1701	(98)
Space heating												2537.2668	(98)
Space heating per m2											(98) / (4) =	25.9169	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2803.6097	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	537.7515	415.5619	318.5092	163.1461	64.4202	0.0000	0.0000	0.0000	0.0000	146.7718	340.9361	550.1701	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	594.2006	459.1844	351.9438	180.2719	71.1825	0.0000	0.0000	0.0000	0.0000	162.1787	376.7250	607.9227	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.4062	112.3451	88.1502	43.8614	22.2168	0.0000	0.0000	19.4661	43.5176	88.5089	123.0830	146.5370	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7956	89.7995	89.7866	89.8025	89.6572	87.3000	87.3000	87.3000	87.3000	89.2691	89.6285	89.8076	(217)
Fuel for water heating, kWh/month	163.0438	125.1066	98.1774	48.8421	24.7797	0.0000	0.0000	22.2980	49.8483	99.1485	137.3257	163.1677	(219)
Water heating fuel used												931.7377	(219)

Annual totals kWh/year		
Space heating fuel - main system	2803.6097	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771	-1368.9771	(233)
Total delivered energy for all uses	2893.7264	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2803.6097	10.2300	286.8093	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	931.7377	10.2300	95.3168	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	402.3561	36.7200	147.7452	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			176.0828	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2803.6097	0.2160	605.5797	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.7377	0.2160	201.2553	(264)
Space and water heating			806.8350	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			370.0337	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2803.6097	1.2200	3420.4038	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.7377	1.2200	1136.7200	(264)
Space and water heating			4557.1238	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	402.3561	3.0700	1235.2333	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1973.3474	(272)
Primary energy kWh/m2/year			20.1568	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	140.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	334.05	(P1)
Transmission heat loss coefficient	69.52	(37)
Summer heat loss coefficient	403.57	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.2900	117.5071	0.4600	0.0000	0.9000	160.0517
South	8.0600	112.2060	0.4600	0.0000	0.9000	374.4135
West	4.3100	117.5071	0.4600	0.0000	0.9000	209.6726
West	3.3300	117.5071	0.4600	0.0000	0.9000	161.9976
total:						906.1353

	Jun	Jul	Aug	
Solar gains	953	906	837	(P4)
Internal gains	480	460	469	
Total summer gains	1433	1367	1306	(P5)
Summer gain/loss ratio	3.55	3.39	3.24	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 140.3)	1.02	1.02	1.02	
Threshold temperature	20.57	22.30	22.06	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-317	**Issued on Date**	27/11/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	3, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	91 B	**DER**	9.48	**TER**	18.89
Environmental	93 A	**% DER<TER**	49.80		
CO_2 Emissions (t/year)	0.45	**DFEE**	46.66	**TFEE**	54.47
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.33		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.89 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.48 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.62 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 0.72 m², No overhang
Windows facing South East: 5.06 m², No overhang
Windows facing North West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.4250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	98.4572	98.1253	97.7999	96.2719	95.9860	94.6550	94.6550	94.4086	95.1677	95.9860	96.5643	97.1690	(39)
Average = Sum(39)m / 12 =												96.2705	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2299	1.2259	1.2067	1.2031	1.1865	1.1865	1.1834	1.1929	1.2031	1.2104	1.2180	(40)
HLP (average)												1.2067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	473.1520	551.4617	632.9657	725.3900	794.3325	789.1115	749.3955	684.4926	610.3009	524.8704	464.5299	446.3778	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9507	34.0656	34.1789	34.7214	34.8248	35.3145	35.3145	35.4067	35.1242	34.8248	34.6162	34.4008	
alpha	3.2634	3.2710	3.2786	3.3148	3.3217	3.3543	3.3543	3.3604	3.3416	3.3217	3.3077	3.2934	
util living area													
	0.9877	0.9790	0.9594	0.9098	0.8113	0.6602	0.5185	0.5762	0.7970	0.9402	0.9802	0.9898	(86)
MIT	19.0257	19.2536	19.6369	20.1470	20.5802	20.8560	20.9525	20.9322	20.7113	20.1464	19.5030	18.9943	(87)
Th 2	19.8928	19.8961	19.8994	19.9146	19.9175	19.9309	19.9309	19.9333	19.9257	19.9175	19.9117	19.9057	(88)
util rest of house													
	0.9850	0.9744	0.9502	0.8886	0.7659	0.5794	0.4070	0.4640	0.7314	0.9218	0.9752	0.9876	(89)
MIT 2	17.2660	17.5984	18.1536	18.8857	19.4707	19.8130	19.9054	19.8936	19.6574	18.9007	17.9731	17.2280	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6295	17.9403	18.4600	19.1462	19.6999	20.0285	20.1217	20.1081	19.8751	19.1580	18.2892	17.5929	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4795	17.7903	18.3100	18.9962	19.5499	19.8785	19.9717	19.9581	19.7251	19.0080	18.1392	17.4429	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9616	0.9319	0.8659	0.7479	0.5751	0.4116	0.4668	0.7169	0.9008	0.9628	0.9798	(94)
Useful gains	461.8249	530.2677	589.8571	628.1024	594.0947	453.8015	308.4267	319.5385	437.5317	472.8026	447.2503	437.3621	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1297.6140	1264.8682	1155.0209	971.9830	753.4786	499.6347	319.1462	335.9165	535.3296	807.0545	1065.9887	1286.7953	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.8271	493.6516	420.4819	247.5940	118.5816	0.0000	0.0000	0.0000	0.0000	248.6834	445.4916	631.9783	(98)
Space heating												3228.2896	(98)
Space heating per m2											(98) / (4) =	40.4649	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3567.1708	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.8271	493.6516	420.4819	247.5940	118.5816	0.0000	0.0000	0.0000	0.0000	248.6834	445.4916	631.9783	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	687.1018	545.4713	464.6209	273.5846	131.0294	0.0000	0.0000	0.0000	0.0000	274.7883	492.2560	698.3186	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8091	89.7537	89.6345	89.3586	88.8100	87.3000	87.3000	87.3000	87.3000	89.3344	89.6789	89.8335	(217)
Fuel for water heating, kWh/month													
	183.9055	161.3764	167.7768	148.1882	144.1636	128.1956	120.4190	135.8687	136.8056	153.8471	165.4048	178.5375	(219)
Water heating fuel used												1824.4888	(219)
Annual totals kWh/year													
Space heating fuel - main system												3567.1708	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4605.0152	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3567.1708	0.2160	770.5089	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.4888	0.2160	394.0896	(264)
Space and water heating			1164.5985	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			756.3300	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.4800	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.9763	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.9763	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	85.2768	154.6843	236.6837	335.2300	413.7914	427.6485	405.2868	344.1005	270.4043	177.7100	103.8586	71.8684	(83)
Total gains	471.9735	538.9378	606.7831	682.9200	738.7483	730.7017	694.5479	639.9946	578.1468	508.0733	460.0920	447.3348	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9960	0.9897	0.9653	0.8897	0.7300	0.5628	0.6263	0.8697	0.9801	0.9962	0.9986	(86)
MIT	19.7022	19.8501	20.1056	20.4558	20.7612	20.9395	20.9868	20.9782	20.8461	20.4544	20.0202	19.6812	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9947	0.9858	0.9516	0.8466	0.6384	0.4385	0.4997	0.8026	0.9698	0.9946	0.9981	(89)
MIT 2	18.2027	18.4206	18.7941	19.3043	19.7145	19.9232	19.9591	19.9570	19.8319	19.3111	18.6794	18.1799	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5125	18.7159	19.0650	19.5422	19.9307	20.1331	20.1714	20.1679	20.0414	19.5472	18.9564	18.4900	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5125	18.7159	19.0650	19.5422	19.9307	20.1331	20.1714	20.1679	20.0414	19.5472	18.9564	18.4900	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9923	0.9814	0.9448	0.8455	0.6546	0.4643	0.5257	0.8088	0.9643	0.9924	0.9970	(94)
Useful gains	470.1654	534.7988	595.5126	645.1906	624.6205	478.3121	322.4530	336.4589	467.6264	489.9447	456.5970	446.0112	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.4328	1303.9224	1182.3200	987.3094	761.5543	505.5763	326.3303	343.4833	545.5241	827.8482	1102.9541	1336.8330	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	651.1990	516.8511	436.5847	246.3255	101.8788	0.0000	0.0000	0.0000	0.0000	251.4002	465.3771	662.7714	(98)
Space heating												3332.3877	(98)
Space heating per m2											(98) / (4) =	41.7697	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3567.8670	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	651.1990	516.8511	436.5847	246.3255	101.8788	0.0000	0.0000	0.0000	0.0000	251.4002	465.3771	662.7714	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	697.2152	553.3738	467.4354	263.7318	109.0779	0.0000	0.0000	0.0000	0.0000	269.1651	498.2624	709.6054	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7858	87.5864	87.1446	86.0791	83.9724	80.3000	80.3000	80.3000	80.3000	86.0123	87.2996	87.8654	(217)
Fuel for water heating, kWh/month													
	230.1098	202.4061	211.6582	190.0539	188.6220	173.7253	166.4421	185.5439	187.5930	199.4256	209.7437	224.4772	(219)
Water heating fuel used												2369.8007	(219)
Annual totals kWh/year													
Space heating fuel - main system												3567.8670	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6369.5804	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3567.8670	0.2160	770.6593	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2369.8007	0.2160	511.8770	(264)
Space and water heating			1282.5362	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1506.6989	(272)
Emissions per m2 for space and water heating			16.0759	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0759 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.3765	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3482	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4440	0.4353	0.4266	0.3831	0.3744	0.3308	0.3308	0.3221	0.3482	0.3744	0.3918	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7362	40.4758	40.2204	39.0212	38.7968	37.7523	37.7523	37.5589	38.1546	38.7968	39.2507	39.7253	(38)
Heat transfer coeff	96.6179	96.3574	96.1021	94.9028	94.6784	93.6339	93.6339	93.4405	94.0363	94.6784	95.1323	95.6069	(39)
Average = Sum(39)m / 12 =												94.9017	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2111	1.2078	1.2046	1.1896	1.1867	1.1737	1.1737	1.1712	1.1787	1.1867	1.1924	1.1984	(40)
HLP (average)												1.1895	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	441.0456	520.1333	603.2523	697.8697	768.2369	765.0198	727.0041	659.9196	584.9504	497.2503	434.3467	415.0440	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5970	34.6906	34.7827	35.2223	35.3058	35.6996	35.6996	35.7735	35.5469	35.3058	35.1373	34.9629	
alpha	3.3065	3.3127	3.3188	3.3482	3.3537	3.3800	3.3800	3.3849	3.3698	3.3537	3.3425	3.3309	
util living area													
	0.9900	0.9820	0.9638	0.9164	0.8198	0.6701	0.5274	0.5885	0.8094	0.9472	0.9836	0.9918	(86)
MIT	19.0139	19.2424	19.6272	20.1365	20.5742	20.8524	20.9513	20.9293	20.7015	20.1276	19.4820	18.9774	(87)
Th 2	19.9112	19.9138	19.9163	19.9284	19.9306	19.9411	19.9411	19.9431	19.9371	19.9306	19.9261	19.9213	(88)
util rest of house													
	0.9878	0.9781	0.9555	0.8964	0.7758	0.5900	0.4158	0.4762	0.7460	0.9307	0.9794	0.9900	(89)
MIT 2	18.1010	18.3296	18.7112	19.2138	19.6193	19.8581	19.9231	19.9145	19.7456	19.2163	18.5782	18.0720	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2895	18.5181	18.9004	19.4044	19.8166	20.0635	20.1355	20.1241	19.9431	19.4045	18.7649	18.2590	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2895	18.5181	18.9004	19.4044	19.8166	20.0635	20.1355	20.1241	19.9431	19.4045	18.7649	18.2590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9833	0.9713	0.9456	0.8846	0.7704	0.6001	0.4374	0.4969	0.7465	0.9203	0.9731	0.9861	(94)
Useful gains	433.6621	505.2176	570.4172	617.3646	591.8690	459.0658	318.0035	327.9173	436.6378	457.5954	422.6523	409.2831	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1351.6389	1312.2073	1191.7064	996.8990	768.4641	511.5667	331.0443	347.9817	549.4592	833.5980	1109.7109	1344.1411	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	682.9748	542.2971	462.2392	273.2647	131.3868	0.0000	0.0000	0.0000	0.0000	279.7459	494.6822	695.5344	(98)
Space heating												3562.1251	(98)
Space heating per m2											(98) / (4) =	44.6493	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	880.1589	692.8911	710.1478	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8134	0.8727	0.8407	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	715.9410	604.7091	597.0043	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	986.1124	939.8049	863.0181	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	194.5235	249.3113	197.9143	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												641.7490	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	48.6309	62.3278	49.4786	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												160.4373	(107)
Space cooling per m2												2.0110	(108)
Energy for space heating												44.6493	(99)
Energy for space cooling												2.0110	(108)
Total												46.6603	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	85.2768	154.6843	236.6837	335.2300	413.7914	427.6485	405.2868	344.1005	270.4043	177.7100	103.8586	71.8684	(83)
Total gains	427.4881	495.5413	565.6238	644.5741	702.4515	697.0313	662.5708	605.2137	541.9609	468.9976	417.8351	403.6182	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9973	0.9923	0.9721	0.9052	0.7537	0.5866	0.6555	0.8917	0.9856	0.9975	0.9991	(86)
MIT	19.6506	19.8002	20.0596	20.4175	20.7360	20.9300	20.9842	20.9733	20.8232	20.4124	19.9715	19.6302	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9963	0.9894	0.9607	0.8658	0.6630	0.4587	0.5261	0.8309	0.9779	0.9965	0.9988	(89)
MIT 2	18.6995	18.8511	19.1113	19.4732	19.7698	19.9310	19.9599	19.9583	19.8563	19.4744	19.0332	18.6881	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8960	19.0471	19.3072	19.6683	19.9694	20.1374	20.1715	20.1680	20.0560	19.6682	19.2270	18.8827	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8960	19.0471	19.3072	19.6683	19.9694	20.1374	20.1715	20.1680	20.0560	19.6682	19.2270	18.8827	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9952	0.9871	0.9569	0.8666	0.6797	0.4854	0.5530	0.8377	0.9751	0.9955	0.9984	(94)
Useful gains	426.5480	493.1436	558.3069	616.7684	608.7375	473.7413	321.6152	334.7070	453.9968	457.2987	415.9417	402.9524	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7359	1335.1815	1205.1141	999.0044	765.1287	505.9680	326.3394	343.4863	546.8623	839.0388	1128.1314	1373.5691	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.6598	565.8495	481.2246	275.2099	116.3550	0.0000	0.0000	0.0000	0.0000	284.0147	512.7766	722.1388	(98)
Space heating												3668.2289	(98)
Space heating per m2											(98) / (4) =	45.9793	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8562	0.9184	0.8882	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	735.4125	620.9862	615.3373	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	906.6454	864.4932	799.0762	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	123.2877	181.1691	136.7017	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												441.1586	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	30.8219	45.2923	34.1754	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												110.2896 (107)
Space cooling per m2												1.3824 (108)
Energy for space heating												45.9793 (99)
Energy for space cooling												1.3824 (108)
Total												47.3617 (109)
Target Fabric Energy Efficiency (TFEE)												54.5 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.4250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	95.7066	94.9081	95.1677	94.6550	94.6550	94.4086	94.1687	93.9354	93.7086	94.4086	93.9354	94.4086	(39)
Average = Sum(39)m / 12 =												94.5055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1996	1.1896	1.1929	1.1865	1.1865	1.1834	1.1804	1.1774	1.1746	1.1834	1.1774	1.1834	(40)
HLP (average)												1.1846	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	123.5815	191.6670	297.7436	426.8829	501.9417	563.6258	529.9494	460.5125	360.2735	238.1996	150.2084	102.2626	(83)
Total gains	677.5739	741.2570	825.9531	921.9795	963.1646	994.5140	943.1220	881.9664	800.7968	712.0473	661.0730	641.1046	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9265	35.2203	35.1242	35.3145	35.3145	35.4067	35.4969	35.5850	35.6711	35.4067	35.5850	35.4067	
alpha	3.3284	3.3480	3.3416	3.3543	3.3543	3.3604	3.3665	3.3723	3.3781	3.3604	3.3723	3.3604	
util living area	0.9626	0.9490	0.9121	0.8297	0.6968	0.5072	0.3793	0.4026	0.6433	0.8536	0.9390	0.9669	(86)
MIT	19.4958	19.6651	20.0182	20.4504	20.7734	20.9428	20.9838	20.9807	20.8719	20.4925	19.9618	19.4860	(87)
Th 2	19.9203	19.9283	19.9257	19.9309	19.9309	19.9333	19.9357	19.9381	19.9404	19.9333	19.9381	19.9333	(88)
util rest of house	0.9550	0.9390	0.8945	0.7960	0.6382	0.4238	0.2802	0.2985	0.5617	0.8157	0.9249	0.9601	(89)
MIT 2	17.9607	18.2075	18.7055	19.3003	19.7103	19.8936	19.9289	19.9298	19.8374	19.3737	18.6429	17.9557	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2778	18.5086	18.9767	19.5379	19.9299	20.1103	20.1468	20.1469	20.0511	19.6048	18.9153	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1278	18.3586	18.8267	19.3879	19.7799	19.9603	19.9968	19.9969	19.9011	19.4548	18.7653	18.1218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9378	0.9195	0.8720	0.7761	0.6291	0.4260	0.2861	0.3045	0.5584	0.7953	0.9042	0.9441	(94)
Useful gains	635.4362	681.5722	720.1989	715.5442	605.9698	423.6787	269.7976	268.5360	447.1710	566.3052	597.7598	605.2656	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1265.9864	1239.3635	1125.5160	935.9392	689.0805	439.9762	272.7887	272.1242	487.3899	760.4442	1020.6392	1238.8138	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.1293	374.8357	301.5560	158.6844	61.8344	0.0000	0.0000	0.0000	0.0000	144.4394	304.4732	471.3599	(98)

Space heating 2286.3123 (98)
RHI space heating demand 2286 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	98.4572	98.1253	97.7999	96.2719	95.9860	94.6550	94.6550	94.4086	95.1677	95.9860	96.5643	97.1690	(39)
Average = Sum(39)m / 12 =												96.2705	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2299	1.2259	1.2067	1.2031	1.1865	1.1865	1.1834	1.1929	1.2031	1.2104	1.2180	(40)
HLP (average)												1.2067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	652.8268	728.8662	802.5217	883.6221	940.7997	926.5252	882.8928	820.2602	753.9171	679.8104	631.2348	622.1362	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9507	34.0656	34.1789	34.7214	34.8248	35.3145	35.3145	35.4067	35.1242	34.8248	34.6162	34.4008	
alpha	3.2634	3.2710	3.2786	3.3148	3.3217	3.3543	3.3543	3.3604	3.3416	3.3217	3.3077	3.2934	
util living area													
	0.9698	0.9555	0.9264	0.8613	0.7480	0.5893	0.4509	0.4981	0.7140	0.8901	0.9546	0.9738	(86)
MIT	19.3039	19.5165	19.8659	20.3177	20.6805	20.8984	20.9688	20.9563	20.7992	20.3351	19.7515	19.2706	(87)
Th 2	19.8928	19.8961	19.8994	19.9146	19.9175	19.9309	19.9309	19.9333	19.9257	19.9175	19.9117	19.9057	(88)
util rest of house													
	0.9638	0.9466	0.9115	0.8328	0.6969	0.5098	0.3498	0.3947	0.6408	0.8611	0.9440	0.9685	(89)
MIT 2	17.6667	17.9739	18.4738	19.1116	19.5878	19.8507	19.9147	19.9089	19.7486	19.1522	18.3264	17.6269	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0049	18.2925	18.7614	19.3607	19.8135	20.0671	20.1325	20.1252	19.9656	19.3966	18.6208	17.9665	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8549	18.1425	18.6114	19.2107	19.6635	19.9171	19.9825	19.9752	19.8156	19.2466	18.4708	17.8165	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9276	0.8890	0.8108	0.6835	0.5087	0.3548	0.3990	0.6324	0.8387	0.9250	0.9541	(94)
Useful gains	618.8835	676.1153	713.4713	716.4093	642.9935	471.3696	313.2902	327.2702	476.7704	570.1246	583.8730	593.5551	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1334.5747	1299.4273	1184.4913	992.6347	764.3823	503.2934	320.1667	337.5338	543.9449	829.9481	1098.0123	1323.0976	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	532.4743	418.8656	350.4389	198.8823	90.3133	0.0000	0.0000	0.0000	0.0000	193.3087	370.1803	542.7796	(98)
Space heating												2697.2429	(98)
Space heating per m2											(98) / (4) =	33.8085	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2980.3789	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.4743	418.8656	350.4389	198.8823	90.3133	0.0000	0.0000	0.0000	0.0000	193.3087	370.1803	542.7796	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.3694	462.8350	387.2253	219.7594	99.7937	0.0000	0.0000	0.0000	0.0000	213.6007	409.0390	599.7565	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7214	89.6556	89.5147	89.1932	88.5958	87.3000	87.3000	87.3000	87.3000	89.1422	89.5609	89.7496	(217)
Fuel for water heating, kWh/month													
	184.0853	161.5529	168.0012	148.4630	144.5121	128.1956	120.4190	135.8687	136.8056	154.1788	165.6228	178.7043	(219)
Water heating fuel used												1826.4094	(219)
Annual totals kWh/year													
Space heating fuel - main system												2980.3789	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4020.1439	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2980.3789	3.4800	103.7172	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4094	3.4800	63.5590	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			183.5178	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6177	(257)
SAP value		91.3830	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2980.3789	0.2160	643.7618	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4094	0.2160	394.5044	(264)
Space and water heating			1038.2663	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			629.9978	(272)
CO2 emissions per m2			7.9000	(273)
EI value			93.2345	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.4250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	95.7066	94.9081	95.1677	94.6550	94.6550	94.4086	94.1687	93.9354	93.7086	94.4086	93.9354	94.4086	(39)
Average = Sum(39)m / 12 =												94.5055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1996	1.1896	1.1929	1.1865	1.1865	1.1834	1.1804	1.1774	1.1746	1.1834	1.1774	1.1834	(40)
HLP (average)												1.1846	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	123.5815	191.6670	297.7436	426.8829	501.9417	563.6258	529.9494	460.5125	360.2735	238.1996	150.2084	102.2626	(83)
Total gains	677.5739	741.2570	825.9531	921.9795	963.1646	994.5140	943.1220	881.9664	800.7968	712.0473	661.0730	641.1046	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9265	35.2203	35.1242	35.3145	35.3145	35.4067	35.4969	35.5850	35.6711	35.4067	35.5850	35.4067	
alpha	3.3284	3.3480	3.3416	3.3543	3.3543	3.3604	3.3665	3.3723	3.3781	3.3604	3.3723	3.3604	
util living area													
	0.9626	0.9490	0.9121	0.8297	0.6968	0.5072	0.3793	0.4026	0.6433	0.8536	0.9390	0.9669	(86)
MIT	19.4958	19.6651	20.0182	20.4504	20.7734	20.9428	20.9838	20.9807	20.8719	20.4925	19.9618	19.4860	(87)
Th 2	19.9203	19.9283	19.9257	19.9309	19.9309	19.9333	19.9357	19.9381	19.9404	19.9333	19.9381	19.9333	(88)
util rest of house													
	0.9550	0.9390	0.8945	0.7960	0.6382	0.4238	0.2802	0.2985	0.5617	0.8157	0.9249	0.9601	(89)
MIT 2	17.9607	18.2075	18.7055	19.3003	19.7103	19.8936	19.9289	19.9298	19.8374	19.3737	18.6429	17.9557	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2778	18.5086	18.9767	19.5379	19.9299	20.1103	20.1468	20.1469	20.0511	19.6048	18.9153	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1278	18.3586	18.8267	19.3879	19.7799	19.9603	19.9968	19.9969	19.9011	19.4548	18.7653	18.1218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9378	0.9195	0.8720	0.7761	0.6291	0.4260	0.2861	0.3045	0.5584	0.7953	0.9042	0.9441	(94)
Useful gains	635.4362	681.5722	720.1989	715.5442	605.9698	423.6787	269.7976	268.5360	447.1710	566.3052	597.7598	605.2656	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1265.9864	1239.3635	1125.5160	935.9392	689.0805	439.9762	272.7887	272.1242	487.3899	760.4442	1020.6392	1238.8138	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	469.1293	374.8357	301.5560	158.6844	61.8344	0.0000	0.0000	0.0000	0.0000	144.4394	304.4732	471.3599	(98)
Space heating												2286.3123	(98)
Space heating per m2											(98) / (4) =	28.6577	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2526.3119	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	469.1293	374.8357	301.5560	158.6844	61.8344	0.0000	0.0000	0.0000	0.0000	144.4394	304.4732	471.3599	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	518.3749	414.1831	333.2110	175.3419	68.3253	0.0000	0.0000	0.0000	0.0000	159.6015	336.4344	520.8396	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6444	89.5848	89.4095	89.0158	88.3170	87.3000	87.3000	87.3000	87.3000	88.9109	89.4262	89.6656	(217)
Fuel for water heating, kWh/month													
	184.2435	161.6806	168.1990	148.7590	144.9682	128.1956	120.4190	135.8687	136.8056	154.5799	165.8722	178.8719	(219)
Water heating fuel used												1828.4632	(219)
Annual totals kWh/year													
Space heating fuel - main system												2526.3119	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3417.7106	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2526.3119	10.2300	258.4417	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.4632	10.2300	187.0518	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			204.4034	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2526.3119	0.2160	545.6834	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.4632	0.2160	394.9480	(264)
Space and water heating			940.6314	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			454.2950	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2526.3119	1.2200	3082.1006	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.4632	1.2200	2230.7251	(264)
Space and water heating			5312.8256	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2436.0377	(272)
Primary energy kWh/m2/year			30.5344	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (40.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£548	£449	£100
Space heating	£389	£389	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£204	£123	£82
Total cost of uses	£204	£123	£81
Delivered energy	43 kWh/m²	31 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	31 kWh/m²	18 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.4250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	98.4572	98.1253	97.7999	96.2719	95.9860	94.6550	94.6550	94.4086	95.1677	95.9860	96.5643	97.1690	(39)
Average = Sum(39)m / 12 =												96.2705	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2299	1.2259	1.2067	1.2031	1.1865	1.1865	1.1834	1.1929	1.2031	1.2104	1.2180	(40)
HLP (average)												1.2067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector		3.0000 (H1)
Zero-loss collector efficiency		0.7000 (H2)
Collector heat loss coefficient		1.8000 (H3)
Collector 2nd order heat loss coefficient		0.0050 (H3a)
Collector effective heat loss coefficient		1.8063 (H3b)
Collector performance ratio		2.5804 (H4)
Annual solar radiation per m2		1079.5246 (H5)
Overshading factor		0.8000 (H6)
Solar energy available		1813.6014 (H7)
Adjustment factor for showers		1.0000 (H7a)
Solar-to-load ratio		1.2449 (H8)
Utilisation factor		0.5521 (H9)
Collector performance factor		0.8793 (H10)
Dedicated solar storage volume		75.0000 (H11)
Effective solar volume		75.0000 (H13)
Daily hot water demand		92.5935 (H14)
Volume ratio Veff/V		0.8100 (H15)
Solar storage volume factor		0.9579 (H16)
Solar input		-843.3953 (H17)

Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)
								Solar input (sum of months) = Sum(63)m =				-843.3953 (63)
Output from w/h												
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)
								Total per year (kWh/year) = Sum(64)m =				786.4412 (64)
Heat gains from water heating, kWh/month												
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942 (83)
Total gains	652.8268	728.8662	802.5217	883.6221	940.7997	926.5252	882.8928	820.2602	753.9171	679.8104	631.2348	622.1362 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9507	34.0656	34.1789	34.7214	34.8248	35.3145	35.3145	35.4067	35.1242	34.8248	34.6162	34.4008	
alpha	3.2634	3.2710	3.2786	3.3148	3.3217	3.3543	3.3543	3.3604	3.3416	3.3217	3.3077	3.2934	
util living area													
	0.9698	0.9555	0.9264	0.8613	0.7480	0.5893	0.4509	0.4981	0.7140	0.8901	0.9546	0.9738	(86)
MIT	19.3039	19.5165	19.8659	20.3177	20.6805	20.8984	20.9688	20.9563	20.7992	20.3351	19.7515	19.2706	(87)
Th 2	19.8928	19.8961	19.8994	19.9146	19.9175	19.9309	19.9309	19.9333	19.9257	19.9175	19.9117	19.9057	(88)
util rest of house													
	0.9638	0.9466	0.9115	0.8328	0.6969	0.5098	0.3498	0.3947	0.6408	0.8611	0.9440	0.9685	(89)
MIT 2	17.6667	17.9739	18.4738	19.1116	19.5878	19.8507	19.9147	19.9089	19.7486	19.1522	18.3264	17.6269	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0049	18.2925	18.7614	19.3607	19.8135	20.0671	20.1325	20.1252	19.9656	19.3966	18.6208	17.9665	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8549	18.1425	18.6114	19.2107	19.6635	19.9171	19.9825	19.9752	19.8156	19.2466	18.4708	17.8165	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9276	0.8890	0.8108	0.6835	0.5087	0.3548	0.3990	0.6324	0.8387	0.9250	0.9541	(94)
Useful gains	618.8835	676.1153	713.4713	716.4093	642.9935	471.3696	313.2902	327.2702	476.7704	570.1246	583.8730	593.5551	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1334.5747	1299.4273	1184.4913	992.6347	764.3823	503.2934	320.1667	337.5338	543.9449	829.9481	1098.0123	1323.0976	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	532.4743	418.8656	350.4389	198.8823	90.3133	0.0000	0.0000	0.0000	0.0000	193.3087	370.1803	542.7796	(98)
Space heating												2697.2429	(98)
Space heating per m2											(98) / (4) =	33.8085	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2980.3789	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	532.4743	418.8656	350.4389	198.8823	90.3133	0.0000	0.0000	0.0000	0.0000	193.3087	370.1803	542.7796	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	588.3694	462.8350	387.2253	219.7594	99.7937	0.0000	0.0000	0.0000	0.0000	213.6007	409.0390	599.7565	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8119	89.8448	89.8822	89.9563	90.0859	87.3000	87.3000	87.3000	87.3000	89.4959	89.6985	89.8252	(217)
Fuel for water heating, kWh/month	156.6687	115.7884	89.9839	43.6509	14.3750	0.0000	0.0000	24.1300	49.2919	95.2743	133.0278	155.7696	(219)
Water heating fuel used												877.9604	(219)
Annual totals kWh/year													
Space heating fuel - main system												2980.3789	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3121.6949	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2980.3789	3.4800	103.7172	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9604	3.4800	30.5530	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			157.1068	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5288	(257)
SAP value	92.6231	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2980.3789	0.2160	643.7618	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9604	0.2160	189.6394	(264)
Space and water heating			833.4013	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			451.0828	(272)
CO2 emissions per m2			5.6500	(273)
EI value			95.1559	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.4250	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	95.7066	94.9081	95.1677	94.6550	94.6550	94.4086	94.1687	93.9354	93.7086	94.4086	93.9354	94.4086	(39)
Average = Sum(39)m / 12 =												94.5055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1996	1.1896	1.1929	1.1865	1.1865	1.1834	1.1804	1.1774	1.1746	1.1834	1.1774	1.1834	(40)
HLP (average)												1.1846	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	123.5815	191.6670	297.7436	426.8829	501.9417	563.6258	529.9494	460.5125	360.2735	238.1996	150.2084	102.2626	(83)
Total gains	677.5739	741.2570	825.9531	921.9795	963.1646	994.5140	943.1220	881.9664	800.7968	712.0473	661.0730	641.1046	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9265	35.2203	35.1242	35.3145	35.3145	35.4067	35.4969	35.5850	35.6711	35.4067	35.5850	35.4067	
alpha	3.3284	3.3480	3.3416	3.3543	3.3543	3.3604	3.3665	3.3723	3.3781	3.3604	3.3723	3.3604	
util living area													
	0.9626	0.9490	0.9121	0.8297	0.6968	0.5072	0.3793	0.4026	0.6433	0.8536	0.9390	0.9669	(86)
MIT	19.4958	19.6651	20.0182	20.4504	20.7734	20.9428	20.9838	20.9807	20.8719	20.4925	19.9618	19.4860	(87)
Th 2	19.9203	19.9283	19.9257	19.9309	19.9309	19.9333	19.9357	19.9381	19.9404	19.9333	19.9381	19.9333	(88)
util rest of house													
	0.9550	0.9390	0.8945	0.7960	0.6382	0.4238	0.2802	0.2985	0.5617	0.8157	0.9249	0.9601	(89)
MIT 2	17.9607	18.2075	18.7055	19.3003	19.7103	19.8936	19.9289	19.9298	19.8374	19.3737	18.6429	17.9557	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2778	18.5086	18.9767	19.5379	19.9299	20.1103	20.1468	20.1469	20.0511	19.6048	18.9153	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1278	18.3586	18.8267	19.3879	19.7799	19.9603	19.9968	19.9969	19.9011	19.4548	18.7653	18.1218	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9378	0.9195	0.8720	0.7761	0.6291	0.4260	0.2861	0.3045	0.5584	0.7953	0.9042	0.9441	(94)
Useful gains	635.4362	681.5722	720.1989	715.5442	605.9698	423.6787	269.7976	268.5360	447.1710	566.3052	597.7598	605.2656	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1265.9864	1239.3635	1125.5160	935.9392	689.0805	439.9762	272.7887	272.1242	487.3899	760.4442	1020.6392	1238.8138	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.1293	374.8357	301.5560	158.6844	61.8344	0.0000	0.0000	0.0000	0.0000	144.4394	304.4732	471.3599	(98)
Space heating												2286.3123	(98)
Space heating per m2											(98) / (4) =	28.6577	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2526.3119	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	469.1293	374.8357	301.5560	158.6844	61.8344	0.0000	0.0000	0.0000	0.0000	144.4394	304.4732	471.3599	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	518.3749	414.1831	333.2110	175.3419	68.3253	0.0000	0.0000	0.0000	0.0000	159.6015	336.4344	520.8396	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7580	89.7840	89.8058	89.8604	89.7770	87.3000	87.3000	87.3000	87.3000	89.3200	89.6021	89.7595	(217)
Fuel for water heating, kWh/month	152.1892	116.0876	89.7286	42.5513	19.3914	0.0000	0.0000	17.2721	43.9527	91.1284	127.8452	152.5190	(219)
Water heating fuel used												852.6655	(219)
Annual totals kWh/year													
Space heating fuel - main system												2526.3119	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2491.9129	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2526.3119	10.2300	258.4417	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.6655	10.2300	87.2277	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			122.9393	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2526.3119	0.2160	545.6834	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6655	0.2160	184.1757	(264)
Space and water heating			729.8591	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			269.4726	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2526.3119	1.2200	3082.1006	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6655	1.2200	1040.2519	(264)
Space and water heating			4122.3524	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1399.0644	(272)
Primary energy kWh/m2/year			17.5365	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South East	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
North West	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						588.0057

	Jun	Jul	Aug	
Solar gains	627	588	510	(P4)
Internal gains	428	410	418	
Total summer gains	1055	998	928	(P5)
Summer gain/loss ratio	3.22	3.04	2.83	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.16	21.89	21.57	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-318	**Issued on Date**	27/11/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	5, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	91 B	**DER**	9.40	**TER**	18.80
Environmental	93 A	**% DER<TER**	49.99		
CO_2 Emissions (t/year)	0.45	**DFEE**	46.33	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.22		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.40 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.66 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 5.06 m², No overhang
Windows facing South West: 0.72 m², No overhang
Windows facing North West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	479.6579	561.5879	644.2821	735.1563	801.3877	794.4072	755.2121	692.5931	621.1219	535.3775	472.1484	452.0581	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9872	0.9779	0.9575	0.9071	0.8083	0.6575	0.5153	0.5712	0.7907	0.9372	0.9793	0.9894	(86)
MIT	19.0344	19.2675	19.6516	20.1575	20.5851	20.8577	20.9533	20.9339	20.7188	20.1596	19.5137	19.0020	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9845	0.9731	0.9480	0.8854	0.7626	0.5766	0.4043	0.4594	0.7243	0.9181	0.9740	0.9871	(89)
MIT 2	17.2780	17.6181	18.1739	18.8994	19.4760	19.8142	19.9054	19.8943	19.6650	18.9182	17.9881	17.2387	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6408	17.9588	18.4792	19.1593	19.7051	20.0298	20.1219	20.1090	19.8827	19.1746	18.3032	17.6030	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4908	17.8088	18.3292	19.0093	19.5551	19.8798	19.9719	19.9590	19.7327	19.0246	18.1532	17.4530	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9599	0.9292	0.8626	0.7448	0.5724	0.4089	0.4623	0.7103	0.8968	0.9613	0.9791	(94)
Useful gains	467.7691	539.0487	598.6988	634.1367	596.8838	454.7305	308.7879	320.2171	441.1587	480.1288	453.8812	442.6208	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1299.7938	1267.6783	1157.7730	973.8458	754.4306	499.9917	319.3150	336.1537	536.3302	809.1298	1068.0430	1288.6858	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	619.0264	489.6391	415.9512	244.5906	117.2148	0.0000	0.0000	0.0000	0.0000	244.7767	442.1965	629.4724	(98)
Space heating												3202.8676	(98)
Space heating per m2											(98) / (4) =	40.1462	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3539.0803	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	619.0264	489.6391	415.9512	244.5906	117.2148	0.0000	0.0000	0.0000	0.0000	244.7767	442.1965	629.4724	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	684.0070	541.0377	459.6146	270.2659	129.5191	0.0000	0.0000	0.0000	0.0000	270.4715	488.6149	695.5496	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8067	89.7490	89.6276	89.3497	88.8007	87.3000	87.3000	87.3000	87.3000	89.3227	89.6743	89.8314	(217)
Fuel for water heating, kWh/month													
	183.9105	161.3848	167.7896	148.2031	144.1786	128.1956	120.4190	135.8687	136.8056	153.8674	165.4132	178.5417	(219)
Water heating fuel used												1824.5778	(219)
Annual totals kWh/year													
Space heating fuel - main system												3539.0803	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4577.0136	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3539.0803	0.2160	764.4413	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5778	0.2160	394.1088	(264)
Space and water heating			1158.5501	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			750.2817	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.4000	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.8963	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.8963	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	477.5869	547.6749	616.5471	691.3466	744.8356	735.2710	699.5666	646.9839	587.4835	517.1391	466.6654	452.2359	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9980	0.9957	0.9889	0.9637	0.8870	0.7269	0.5592	0.6206	0.8638	0.9786	0.9960	0.9985	(86)
MIT	19.7087	19.8601	20.1164	20.4641	20.7652	20.9407	20.9872	20.9790	20.8516	20.4640	20.0278	19.6869	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9973	0.9943	0.9849	0.9494	0.8433	0.6351	0.4355	0.4946	0.7952	0.9677	0.9943	0.9980	(89)
MIT 2	18.2122	18.4352	18.8096	19.3156	19.7192	19.9241	19.9593	19.9574	19.8374	19.3243	18.6903	18.1882	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9918	0.9803	0.9426	0.8424	0.6514	0.4611	0.5206	0.8020	0.9621	0.9920	0.9969	(94)
Useful gains	475.6656	543.1912	604.4008	651.6306	627.4780	478.9734	322.5858	336.8015	471.1769	497.5321	462.9126	450.8347	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1346.2718	1305.2056	1183.6873	988.2939	761.9733	505.6645	326.3480	343.5284	546.0281	829.0043	1103.9086	1337.5610	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating												3301.1128	(98)
Space heating per m2											(98) / (4) =	41.3777	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3534.3820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	693.5022	548.2588	461.4445	259.5263	107.1355	0.0000	0.0000	0.0000	0.0000	264.0421	494.1297	706.3430	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7754	87.5675	87.1161	86.0393	83.9305	80.3000	80.3000	80.3000	80.3000	85.9645	87.2817	87.8566	(217)
Fuel for water heating, kWh/month													
	230.1369	202.4498	211.7275	190.1418	188.7161	173.7253	166.4421	185.5439	187.5930	199.5363	209.7868	224.4996	(219)
Water heating fuel used												2370.2991	(219)
Annual totals kWh/year													
Space heating fuel - main system												3534.3820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6336.5938	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3534.3820	0.2160	763.4265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.2991	0.2160	511.9846	(264)
Space and water heating			1275.4111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1499.5738	(272)
Emissions per m2 for space and water heating			15.9866	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9866 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.3785	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3501	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4464	0.4376	0.4289	0.3851	0.3763	0.3326	0.3326	0.3238	0.3501	0.3763	0.3938	0.4113	(22b)
Effective ac	0.5996	0.5957	0.5920	0.5741	0.5708	0.5553	0.5553	0.5524	0.5613	0.5708	0.5776	0.5846	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.8077	40.5444	40.2864	39.0744	38.8476	37.7920	37.7920	37.5965	38.1986	38.8476	39.3064	39.7859	(38)
Heat transfer coeff	96.6893	96.4261	96.1680	94.9560	94.7292	93.6736	93.6736	93.4781	94.0802	94.7292	95.1880	95.6676	(39)
Average = Sum(39)m / 12 =												94.9549	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2119	1.2086	1.2054	1.1902	1.1874	1.1741	1.1741	1.1717	1.1792	1.1874	1.1931	1.1991	(40)
HLP (average)												1.1902	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	447.5515	530.2595	614.5686	707.6361	775.2921	770.3155	732.8207	668.0200	595.7713	507.7574	441.9653	420.7243	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5715	34.6659	34.7589	35.2025	35.2868	35.6845	35.6845	35.7591	35.5302	35.2868	35.1168	34.9407	
alpha	3.3048	3.3111	3.3173	3.3468	3.3525	3.3790	3.3790	3.3839	3.3687	3.3525	3.3411	3.3294	
util living area													
	0.9895	0.9810	0.9620	0.9136	0.8168	0.6673	0.5241	0.5833	0.8030	0.9444	0.9828	0.9915	(86)
MIT	19.0229	19.2569	19.6425	20.1474	20.5793	20.8543	20.9522	20.9312	20.7094	20.1413	19.4931	18.9853	(87)
Th 2	19.9105	19.9131	19.9157	19.9278	19.9301	19.9407	19.9407	19.9427	19.9366	19.9301	19.9255	19.9207	(88)
util rest of house													
	0.9873	0.9769	0.9534	0.8932	0.7724	0.5871	0.4129	0.4714	0.7387	0.9271	0.9783	0.9896	(89)
MIT 2	18.1093	18.3432	18.7254	19.2235	19.6231	19.8589	19.9231	19.9149	19.7511	19.2286	18.5887	18.0795	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2980	18.5320	18.9149	19.4144	19.8206	20.0645	20.1357	20.1249	19.9491	19.4172	18.7755	18.2666	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2980	18.5320	18.9149	19.4144	19.8206	20.0645	20.1357	20.1249	19.9491	19.4172	18.7755	18.2666	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9699	0.9432	0.8814	0.7672	0.5972	0.4345	0.4920	0.7396	0.9165	0.9718	0.9856	(94)
Useful gains	439.7546	514.2824	579.6337	623.7236	594.8251	460.0650	318.4014	328.6896	440.6163	465.3696	429.5142	414.6593	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.4613	1314.4767	1193.9119	998.4016	769.2596	511.8775	331.1978	348.1925	550.2828	835.2438	1111.3656	1345.7189	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	679.7978	537.7306	457.0230	269.7682	129.7793	0.0000	0.0000	0.0000	0.0000	275.1864	490.9330	692.7083	(98)
Space heating												3532.9266	(98)
Space heating per m2											(98) / (4) =	44.2834	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	880.5319	693.1847	710.4337	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8154	0.8745	0.8439	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	717.9748	606.2018	599.5532	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	992.3023	946.6035	872.4862	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	197.5157	253.2589	203.0621	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												653.8368	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	49.3789	63.3147	50.7655	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												163.4592	(107)
Space cooling per m2												2.0489	(108)
Energy for space heating												44.2834	(99)
Energy for space cooling												2.0489	(108)
Total												46.3322	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	433.1016	504.2784	575.3879	653.0008	708.5389	701.6006	667.5895	612.2030	551.2975	478.0634	424.4085	408.5193	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9987	0.9970	0.9917	0.9707	0.9027	0.7505	0.5827	0.6495	0.8862	0.9844	0.9974	0.9991	(86)
MIT	19.6571	19.8103	20.0706	20.4261	20.7404	20.9314	20.9847	20.9744	20.8293	20.4223	19.9791	19.6360	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9983	0.9960	0.9886	0.9588	0.8626	0.6596	0.4554	0.5206	0.8236	0.9762	0.9962	0.9987	(89)
MIT 2	18.7060	18.8611	19.1221	19.4812	19.7733	19.9318	19.9601	19.9587	19.8607	19.4839	19.0407	18.6938	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9862	0.9549	0.8636	0.6763	0.4820	0.5474	0.8309	0.9732	0.9952	0.9983	(94)
Useful gains	432.0941	501.6546	567.4314	623.5564	611.8767	474.5116	321.7777	335.1368	458.0803	465.2667	422.3545	407.8088	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1382.3519	1336.1274	1206.1322	999.7594	765.4717	506.0479	326.3571	343.5322	547.3010	839.9201	1128.8358	1374.1031	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	706.9918	560.7658	475.1934	270.8661	114.2746	0.0000	0.0000	0.0000	0.0000	278.7422	508.6665	718.9230	(98)
Space heating												3634.4234	(98)
Space heating per m2											(98) / (4) =	45.5556	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8585	0.9202	0.8915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.3479	622.1787	617.6341	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	911.9861	870.3592	807.2455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	125.7395	184.6463	141.0709	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												451.4567	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	31.4349	46.1616	35.2677	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												112.8642 (107)
Space cooling per m2												1.4147 (108)
Energy for space heating												45.5556 (99)
Energy for space cooling												1.4147 (108)
Total												46.9703 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b)	= 101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c)	= 104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9614	0.9472	0.9093	0.8265	0.6943	0.5053	0.3774	0.3994	0.6373	0.8489	0.9369	0.9660	(86)
MIT	19.5059	19.6782	20.0306	20.4577	20.7759	20.9433	20.9840	20.9812	20.8755	20.5026	19.9732	19.4950	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9537	0.9369	0.8913	0.7924	0.6355	0.4221	0.2788	0.2960	0.5557	0.8104	0.9224	0.9590	(89)
MIT 2	17.9747	18.2255	18.7221	19.3092	19.7125	19.8936	19.9286	19.9297	19.8403	19.3859	18.6584	17.9683	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2910	18.5256	18.9924	19.5464	19.9322	20.1105	20.1466	20.1469	20.0541	19.6165	18.9300	18.2837	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1410	18.3756	18.8424	19.3964	19.7822	19.9605	19.9966	19.9969	19.9041	19.4665	18.7800	18.1337	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9362	0.9171	0.8687	0.7727	0.6266	0.4243	0.2846	0.3019	0.5527	0.7902	0.9015	0.9428	(94)
Useful gains	641.6505	689.1774	727.2583	719.6467	607.4052	424.0592	269.9379	268.7266	448.8031	571.5915	604.1525	610.7287	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1267.9792	1241.5972	1127.5982	937.1891	689.6184	440.1861	272.8866	272.2292	487.8568	761.8926	1022.4265	1240.4927	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.9886	371.2261	297.8529	156.6305	61.1666	0.0000	0.0000	0.0000	0.0000	141.5840	301.1573	468.5444	(98)
Space heating												2264.1503	(98)
RHI space heating demand												2264	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.4270	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9690	0.9539	0.9240	0.8582	0.7452	0.5869	0.4485	0.4941	0.7081	0.8864	0.9531	0.9731	(86)
MIT	19.3117	19.5290	19.8786	20.3262	20.6841	20.8995	20.9692	20.9573	20.8042	20.3457	19.7610	19.2777	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9628	0.9448	0.9087	0.8294	0.6939	0.5076	0.3477	0.3913	0.6347	0.8567	0.9423	0.9677	(89)
MIT 2	17.6775	17.9911	18.4909	19.1222	19.5913	19.8512	19.9145	19.9091	19.7531	19.1656	18.3394	17.6366	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0150	18.3088	18.7775	19.3709	19.8170	20.0678	20.1324	20.1256	19.9702	19.4094	18.6331	17.9756	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8650	18.1588	18.6275	19.2209	19.6670	19.9178	19.9824	19.9756	19.8202	19.2594	18.4831	17.8256	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9255	0.8860	0.8074	0.6806	0.5066	0.3528	0.3956	0.6266	0.8344	0.9230	0.9531	(94)
Useful gains	624.2757	683.9253	721.0951	721.3419	645.1318	472.0313	313.5440	327.6986	479.2093	575.9778	589.6863	598.3584	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1336.6695	1302.0531	1186.9758	994.2299	765.1791	503.5929	320.3130	337.7181	544.6653	831.6727	1099.9112	1324.9216	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	530.0210	415.3818	346.6152	196.4794	89.3152	0.0000	0.0000	0.0000	0.0000	190.2370	367.3620	540.5630	(98)
Space heating												2675.9746	(98)
Space heating per m2											(98) / (4) =	33.5419	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2956.8780	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	530.0210	415.3818	346.6152	196.4794	89.3152	0.0000	0.0000	0.0000	0.0000	190.2370	367.3620	540.5630	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	585.6585	458.9855	383.0002	217.1043	98.6908	0.0000	0.0000	0.0000	0.0000	210.2066	405.9249	597.3072	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7187	89.6504	89.5072	89.1838	88.5872	87.3000	87.3000	87.3000	87.3000	89.1297	89.5558	89.7473	(217)
Fuel for water heating, kWh/month													
	184.0909	161.5623	168.0153	148.4787	144.5261	128.1956	120.4190	135.8687	136.8056	154.2005	165.6322	178.7090	(219)
Water heating fuel used												1826.5038	(219)
Annual totals kWh/year													
Space heating fuel - main system												2956.8780	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3996.7374	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2956.8780	3.4800	102.8994	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.5038	3.4800	63.5623	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			182.7033	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6150	(257)
SAP value		91.4212	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2956.8780	0.2160	638.6856	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.5038	0.2160	394.5248	(264)
Space and water heating			1033.2105	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			624.9420	(272)
CO2 emissions per m2			7.8300	(273)
EI value			93.2888	
EI rating			93	(274)
EI band			A	

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Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9614	0.9472	0.9093	0.8265	0.6943	0.5053	0.3774	0.3994	0.6373	0.8489	0.9369	0.9660	(86)
MIT	19.5059	19.6782	20.0306	20.4577	20.7759	20.9433	20.9840	20.9812	20.8755	20.5026	19.9732	19.4950	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9537	0.9369	0.8913	0.7924	0.6355	0.4221	0.2788	0.2960	0.5557	0.8104	0.9224	0.9590	(89)
MIT 2	17.9747	18.2255	18.7221	19.3092	19.7125	19.8936	19.9286	19.9297	19.8403	19.3859	18.6584	17.9683	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2910	18.5256	18.9924	19.5464	19.9322	20.1105	20.1466	20.1469	20.0541	19.6165	18.9300	18.2837	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1410	18.3756	18.8424	19.3964	19.7822	19.9605	19.9966	19.9969	19.9041	19.4665	18.7800	18.1337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9362	0.9171	0.8687	0.7727	0.6266	0.4243	0.2846	0.3019	0.5527	0.7902	0.9015	0.9428	(94)
Useful gains	641.6505	689.1774	727.2583	719.6467	607.4052	424.0592	269.9379	268.7266	448.8031	571.5915	604.1525	610.7287	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1267.9792	1241.5972	1127.5982	937.1891	689.6184	440.1861	272.8866	272.2292	487.8568	761.8926	1022.4265	1240.4927	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.9886	371.2261	297.8529	156.6305	61.1666	0.0000	0.0000	0.0000	0.0000	141.5840	301.1573	468.5444	(98)
Space heating												2264.1503	(98)
Space heating per m2											(98) / (4) =	28.3799	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2501.8236	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	465.9886	371.2261	297.8529	156.6305	61.1666	0.0000	0.0000	0.0000	0.0000	141.5840	301.1573	468.5444	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	514.9045	410.1946	329.1192	173.0724	67.5874	0.0000	0.0000	0.0000	0.0000	156.4464	332.7705	517.7286	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6402	89.5784	89.4006	89.0054	88.3095	87.3000	87.3000	87.3000	87.3000	88.8950	89.4184	89.6619	(217)
Fuel for water heating, kWh/month													
	184.2521	161.6921	168.2158	148.7764	144.9806	128.1956	120.4190	135.8687	136.8056	154.6077	165.8867	178.8792	(219)
Water heating fuel used												1828.5794	(219)
Annual totals kWh/year													
Space heating fuel - main system												2501.8236	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3393.3385	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2501.8236	10.2300	255.9365	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.5794	10.2300	187.0637	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			201.9101	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2501.8236	0.2160	540.3939	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5794	0.2160	394.9732	(264)
Space and water heating			935.3670	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			449.0306	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2501.8236	1.2200	3052.2247	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5794	1.2200	2230.8669	(264)
Space and water heating			5283.0916	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2406.3036	(272)
Primary energy kWh/m2/year			30.1617	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (41.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£546	£446	£100
Space heating	£386	£386	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£202	£120	£82
Total cost of uses	£201	£120	£81
Delivered energy	43 kWh/m²	31 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	30 kWh/m²	17 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9690	0.9539	0.9240	0.8582	0.7452	0.5869	0.4485	0.4941	0.7081	0.8864	0.9531	0.9731	(86)
MIT	19.3117	19.5290	19.8786	20.3262	20.6841	20.8995	20.9692	20.9573	20.8042	20.3457	19.7610	19.2777	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9628	0.9448	0.9087	0.8294	0.6939	0.5076	0.3477	0.3913	0.6347	0.8567	0.9423	0.9677	(89)
MIT 2	17.6775	17.9911	18.4909	19.1222	19.5913	19.8512	19.9145	19.9091	19.7531	19.1656	18.3394	17.6366	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0150	18.3088	18.7775	19.3709	19.8170	20.0678	20.1324	20.1256	19.9702	19.4094	18.6331	17.9756	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8650	18.1588	18.6275	19.2209	19.6670	19.9178	19.9824	19.9756	19.8202	19.2594	18.4831	17.8256	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9255	0.8860	0.8074	0.6806	0.5066	0.3528	0.3956	0.6266	0.8344	0.9230	0.9531	(94)
Useful gains	624.2757	683.9253	721.0951	721.3419	645.1318	472.0313	313.5440	327.6986	479.2093	575.9778	589.6863	598.3584	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1336.6695	1302.0531	1186.9758	994.2299	765.1791	503.5929	320.3130	337.7181	544.6653	831.6727	1099.9112	1324.9216	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	530.0210	415.3818	346.6152	196.4794	89.3152	0.0000	0.0000	0.0000	0.0000	190.2370	367.3620	540.5630	(98)

Space heating 2675.9746 (98)
Space heating per m2 (98) / (4) = 33.5419 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2956.8780 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	530.0210	415.3818	346.6152	196.4794	89.3152	0.0000	0.0000	0.0000	0.0000	190.2370	367.3620	540.5630	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	585.6585	458.9855	383.0002	217.1043	98.6908	0.0000	0.0000	0.0000	0.0000	210.2066	405.9249	597.3072	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8094	89.8404	89.8767	89.9508	90.0819	87.3000	87.3000	87.3000	87.3000	89.4848	89.6939	89.8230	(217)
Fuel for water heating, kWh/month	156.6730	115.7941	89.9893	43.6535	14.3757	0.0000	0.0000	24.1300	49.2919	95.2860	133.0346	155.7734	(219)

Water heating fuel used 878.0016 (219)
Annual totals kWh/year
Space heating fuel - main system 2956.8780 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 3098.2351 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2956.8780	3.4800	102.8994	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.0016	3.4800	30.5545	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			156.2904	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.5261 (257)
SAP value 92.6614
SAP rating (Section 12) 93 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2956.8780	0.2160	638.6856	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.0016	0.2160	189.6483	(264)
Space and water heating			828.3340	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			446.0155	(272)
CO2 emissions per m2			5.5900	(273)
EI value			95.2103	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.4270	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9614	0.9472	0.9093	0.8265	0.6943	0.5053	0.3774	0.3994	0.6373	0.8489	0.9369	0.9660	(86)
MIT	19.5059	19.6782	20.0306	20.4577	20.7759	20.9433	20.9840	20.9812	20.8755	20.5026	19.9732	19.4950	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9537	0.9369	0.8913	0.7924	0.6355	0.4221	0.2788	0.2960	0.5557	0.8104	0.9224	0.9590	(89)
MIT 2	17.9747	18.2255	18.7221	19.3092	19.7125	19.8936	19.9286	19.9297	19.8403	19.3859	18.6584	17.9683	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2910	18.5256	18.9924	19.5464	19.9322	20.1105	20.1466	20.1469	20.0541	19.6165	18.9300	18.2837	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1410	18.3756	18.8424	19.3964	19.7822	19.9605	19.9966	19.9969	19.9041	19.4665	18.7800	18.1337	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9362	0.9171	0.8687	0.7727	0.6266	0.4243	0.2846	0.3019	0.5527	0.7902	0.9015	0.9428	(94)
Useful gains	641.6505	689.1774	727.2583	719.6467	607.4052	424.0592	269.9379	268.7266	448.8031	571.5915	604.1525	610.7287	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1267.9792	1241.5972	1127.5982	937.1891	689.6184	440.1861	272.8866	272.2292	487.8568	761.8926	1022.4265	1240.4927	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	465.9886	371.2261	297.8529	156.6305	61.1666	0.0000	0.0000	0.0000	0.0000	141.5840	301.1573	468.5444	(98)
Space heating												2264.1503	(98)
Space heating per m2											(98) / (4) =	28.3799	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2501.8236	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	465.9886	371.2261	297.8529	156.6305	61.1666	0.0000	0.0000	0.0000	0.0000	141.5840	301.1573	468.5444	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	514.9045	410.1946	329.1192	173.0724	67.5874	0.0000	0.0000	0.0000	0.0000	156.4464	332.7705	517.7286	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7542	89.7786	89.7991	89.8537	89.7709	87.3000	87.3000	87.3000	87.3000	89.3051	89.5950	89.7561	(217)
Fuel for water heating, kWh/month	152.1957	116.0946	89.7353	42.5545	19.3927	0.0000	0.0000	17.2721	43.9527	91.1437	127.8553	152.5248	(219)
Water heating fuel used												852.7213	(219)
Annual totals kWh/year													
Space heating fuel - main system												2501.8236	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2467.4804	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2501.8236	10.2300	255.9365	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.7213	10.2300	87.2334	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			120.4399	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2501.8236	0.2160	540.3939	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7213	0.2160	184.1878	(264)
Space and water heating			724.5817	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			264.1952 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2501.8236	1.2200	3052.2247	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7213	1.2200	1040.3200	(264)
Space and water heating			4092.5447	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1369.2567	(272)
Primary energy kWh/m2/year			17.1629	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
South West	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
North West	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
North West	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						594.2884

	Jun	Jul	Aug	
Solar gains	633	594	519	(P4)
Internal gains	428	410	418	
Total summer gains	1061	1004	938	(P5)
Summer gain/loss ratio	3.23	3.06	2.86	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.18	21.91	21.60	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-319	**Issued on Date**	20/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-As-SEMI
Property	7, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	91 B	**DER**	10.33	**TER**	17.30
Environmental	91 B	**% DER<TER**	40.29		
CO_2 Emissions (t/year)	0.79	**DFEE**	46.69	**TFEE**	54.42
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.20		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.30 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.33 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.7 kWh/m²/yrOK
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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.60 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 5.81 m², No overhang
Windows facing South West: 2.16 m², No overhang
Windows facing North West: 7.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6000	
Infiltration rate		0.3674	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4333	0.4248	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5902	0.5867	0.5699	0.5667	0.5521	0.5521	0.5494	0.5578	0.5667	0.5731	0.5797	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.0400	56.6898	56.3466	54.7344	54.4327	53.0286	53.0286	52.7685	53.5694	54.4327	55.0430	55.6809	(38)
Heat transfer coeff	130.9051	130.5549	130.2116	128.5994	128.2978	126.8936	126.8936	126.6336	127.4345	128.2978	128.9080	129.5459	(39)
Average = Sum(39)m / 12 =												128.5980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1640	1.1609	1.1578	1.1435	1.1408	1.1283	1.1283	1.1260	1.1332	1.1408	1.1463	1.1519	(40)
HLP (average)												1.1435	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	586.8083	693.5016	799.3606	913.5698	995.5734	986.3333	938.1336	860.0337	771.8984	662.6066	579.2824	551.7109	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6782	32.7659	32.8523	33.2641	33.3423	33.7113	33.7113	33.7805	33.5682	33.3423	33.1845	33.0211	
alpha	3.1785	3.1844	3.1902	3.2176	3.2228	3.2474	3.2474	3.2520	3.2379	3.2228	3.2123	3.2014	
util living area	0.9888	0.9802	0.9618	0.9168	0.8271	0.6857	0.5449	0.6012	0.8112	0.9444	0.9819	0.9907	(86)
MIT	18.9209	19.1571	19.5484	20.0643	20.5182	20.8224	20.9384	20.9144	20.6694	20.0766	19.4086	18.8827	(87)
Th 2	19.9489	19.9514	19.9539	19.9655	19.9676	19.9778	19.9778	19.9796	19.9738	19.9676	19.9632	19.9586	(88)
util rest of house	0.9865	0.9762	0.9538	0.8983	0.7868	0.6104	0.4367	0.4938	0.7522	0.9284	0.9775	0.9889	(89)
MIT 2	17.1621	17.5068	18.0744	18.8166	19.4381	19.8238	19.9414	19.9248	19.6526	18.8477	17.8823	17.1124	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.7051	18.0163	18.5295	19.2018	19.7716	20.1321	20.2492	20.2303	19.9665	19.2271	18.3535	17.6589	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5551	17.8663	18.3795	19.0518	19.6216	19.9821	20.0992	20.0803	19.8165	19.0771	18.2035	17.5089	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9787	0.9647	0.9372	0.8777	0.7710	0.6107	0.4504	0.5053	0.7415	0.9097	0.9667	0.9821	(94)
Useful gains	574.2960	669.0397	749.1859	801.8128	767.5875	602.3649	422.5233	434.6174	572.3316	602.7988	559.9899	541.8566	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1735.1598	1692.8188	1546.8436	1305.5158	1016.3190	682.9518	444.0277	466.0540	728.4793	1087.5972	1431.3292	1724.1183	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	863.6827	687.9796	593.4574	362.6662	185.0562	0.0000	0.0000	0.0000	0.0000	360.6900	627.3642	879.6028	(98)
Space heating												4560.4991	(98)
Space heating per m2											(98) / (4) =	40.5522	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5039.2255	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	863.6827	687.9796	593.4574	362.6662	185.0562	0.0000	0.0000	0.0000	0.0000	360.6900	627.3642	879.6028	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	954.3456	760.1984	655.7540	400.7361	204.4820	0.0000	0.0000	0.0000	0.0000	398.5525	693.2202	971.9367	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9327	89.8865	89.7895	89.5680	89.0996	87.3000	87.3000	87.3000	87.3000	89.5396	89.8271	89.9547	(217)
Fuel for water heating, kWh/month	199.6366	175.1311	181.9559	160.4968	155.8992	138.9421	130.3772	147.2980	148.3736	166.6288	179.4099	193.7726	(219)
Water heating fuel used												1977.9218	(219)
Annual totals kWh/year													
Space heating fuel - main system												5039.2255	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6334.1924	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5039.2255	0.2160	1088.4727	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.9218	0.2160	427.2311	(264)
Space and water heating			1515.7038	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1161.2502	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.3300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.3300	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		26.4846	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.4846	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Southwest	2.1600	36.7938	0.6300	0.7000	0.7700	24.2885	(79)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	120.1523	214.9007	321.3872	444.3181	539.9431	554.6818	527.0103	452.7863	363.4866	244.8701	145.7751	101.6236	(83)
Total gains	580.7450	673.0895	763.1944	859.5155	927.2245	915.3986	871.1790	804.2937	729.5453	637.7704	569.3315	548.4733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9990	0.9977	0.9934	0.9758	0.9150	0.7686	0.5988	0.6632	0.8960	0.9868	0.9979	0.9993	(86)
MIT	19.7089	19.8538	20.1005	20.4389	20.7428	20.9321	20.9853	20.9757	20.8348	20.4433	20.0191	19.6894	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9987	0.9969	0.9909	0.9658	0.8791	0.6817	0.4741	0.5380	0.8380	0.9798	0.9970	0.9990	(89)
MIT 2	18.2454	18.4593	18.8208	19.3174	19.7337	19.9617	20.0038	20.0009	19.8623	19.3307	18.7108	18.2246	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6972	18.8898	19.2158	19.6636	20.0452	20.2613	20.3068	20.3019	20.1626	19.6742	19.1147	18.6768	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6972	18.8898	19.2158	19.6636	20.0452	20.2613	20.3068	20.3019	20.1626	19.6742	19.1147	18.6768	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9883	0.9616	0.8811	0.7057	0.5130	0.5769	0.8489	0.9767	0.9958	0.9985	(94)
Useful gains	579.6012	670.1144	754.2294	826.4890	816.9821	646.0049	446.8787	463.9668	619.2874	622.9046	566.9651	547.6694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1827.9561	1770.7847	1604.6776	1339.0230	1035.3723	693.5417	454.1109	476.8728	746.3468	1125.8090	1498.7833	1816.1923	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	928.7760	739.6505	632.7335	369.0245	162.4824	0.0000	0.0000	0.0000	0.0000	374.1609	670.9091	943.7811	(98)
Space heating												4821.5179	(98)
Space heating per m2											(98) / (4) =	42.8732	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5162.2247	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	928.7760	739.6505	632.7335	369.0245	162.4824	0.0000	0.0000	0.0000	0.0000	374.1609	670.9091	943.7811	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	994.4069	791.9170	677.4449	395.1011	173.9640	0.0000	0.0000	0.0000	0.0000	400.6005	718.3181	1010.4723	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3017	88.1282	87.7471	86.8310	84.8875	80.3000	80.3000	80.3000	80.3000	86.7749	87.8926	88.3681	(217)
Fuel for water heating, kWh/month	245.0054	216.3601	228.1802	206.2955	204.3032	190.2188	182.2441	203.1594	205.4031	214.4363	223.9174	238.9158	(219)
Water heating fuel used												2558.4393	(219)
Annual totals kWh/year													
Space heating fuel - main system												5162.2247	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8256.2662	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5162.2247	0.2160	1115.0405	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2558.4393	0.2160	552.6229	(264)
Space and water heating			1667.6634	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1945.6410	(272)
Emissions per m2 for space and water heating			14.8289	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8289 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.3000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6000	
Infiltration rate		0.3674	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4333	0.4248	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5902	0.5867	0.5699	0.5667	0.5521	0.5521	0.5494	0.5578	0.5667	0.5731	0.5797	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.0400	56.6898	56.3466	54.7344	54.4327	53.0286	53.0286	52.7685	53.5694	54.4327	55.0430	55.6809	(38)
Heat transfer coeff	130.9051	130.5549	130.2116	128.5994	128.2978	126.8936	126.8936	126.6336	127.4345	128.2978	128.9080	129.5459	(39)
Average = Sum(39)m / 12 =												128.5980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1640	1.1609	1.1578	1.1435	1.1408	1.1283	1.1283	1.1260	1.1332	1.1408	1.1463	1.1519	(40)
HLP (average)												1.1435	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	552.3775	659.9202	767.5431	884.1511	967.7157	960.6709	914.3338	833.8437	744.8564	633.0820	546.9551	518.1259	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1313	32.2175	32.3024	32.7074	32.7843	33.1470	33.1470	33.2151	33.0064	32.7843	32.6291	32.4684	
alpha	3.1421	3.1478	3.1535	3.1805	3.1856	3.2098	3.2098	3.2143	3.2004	3.1856	3.1753	3.1646	
util living area	0.9901	0.9820	0.9644	0.9210	0.8339	0.6950	0.5548	0.6133	0.8209	0.9489	0.9838	0.9919	(86)
MIT	18.8536	19.0946	19.4944	20.0231	20.4910	20.8089	20.9325	20.9059	20.6462	20.0330	19.3500	18.8156	(87)
Th 2	19.9489	19.9514	19.9539	19.9655	19.9676	19.9778	19.9778	19.9796	19.9738	19.9676	19.9632	19.9586	(88)
util rest of house	0.9881	0.9784	0.9570	0.9034	0.7948	0.6204	0.4460	0.5057	0.7638	0.9341	0.9800	0.9902	(89)
MIT 2	17.9812	18.2223	18.6194	19.1433	19.5832	19.8634	19.9501	19.9378	19.7366	19.1629	18.4864	17.9504	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.2506	18.4916	18.8896	19.4149	19.8635	20.1553	20.2534	20.2367	20.0174	19.4316	18.7530	18.2176	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2506	18.4916	18.8896	19.4149	19.8635	20.1553	20.2534	20.2367	20.0174	19.4316	18.7530	18.2176	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9716	0.9472	0.8921	0.7903	0.6345	0.4771	0.5349	0.7666	0.9243	0.9739	0.9864	(94)
Useful gains	543.3170	641.1901	727.0276	788.7671	764.7551	609.5282	436.1927	446.0412	571.0039	585.1522	532.6802	511.0906	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1826.1980	1774.4452	1613.2644	1352.2102	1047.3577	704.9347	463.5967	485.8529	754.0798	1133.0691	1502.1692	1815.9172	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

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	954.4635	761.5474	659.3602	405.6790	210.2563	0.0000	0.0000	0.0000	0.0000	407.6502	698.0321	970.7910 (98)
Space heating												5067.7797 (98)
Space heating per m2											(98) / (4) =	45.0630 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1192.7998	939.0126	962.4150	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7735	0.8391	0.8052	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	922.6095	787.9613	774.9034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1228.1873	1172.0721	1081.5844	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	220.0160	285.7784	228.1706	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												733.9650	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.0040	71.4446	57.0427	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												183.4913	(107)
Space cooling per m2												1.6316	(108)
Energy for space heating												45.0630	(99)
Energy for space cooling												1.6316	(108)
Total												46.6946	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288 (42)
Average daily hot water use (litres/day)	101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Southwest	2.1600	36.7938	0.6300	0.7000	0.7700	24.2885	(79)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	120.1523	214.9007	321.3872	444.3181	539.9431	554.6818	527.0103	452.7863	363.4866	244.8701	145.7751	101.6236	(83)
Total gains	533.9467	627.1364	718.9965	817.8139	887.7665	878.8164	836.4508	766.4955	690.2087	595.8539	524.6262	502.5167	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9993	0.9983	0.9949	0.9802	0.9265	0.7885	0.6200	0.6888	0.9127	0.9902	0.9986	0.9995	(86)
MIT	19.6698	19.8157	20.0645	20.4077	20.7209	20.9231	20.9828	20.9710	20.8149	20.4102	19.9819	19.6509	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9991	0.9977	0.9930	0.9719	0.8938	0.7032	0.4927	0.5620	0.8604	0.9848	0.9979	0.9994	(89)
MIT 2	18.7558	18.9037	19.1539	19.5029	19.7994	19.9718	20.0049	20.0027	19.8929	19.5104	19.0806	18.7456	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0380	19.1853	19.4351	19.7822	20.0839	20.2655	20.3068	20.3017	20.1775	19.7882	19.3588	19.0251	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0380	19.1853	19.4351	19.7822	20.0839	20.2655	20.3068	20.3017	20.1775	19.7882	19.3588	19.0251	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9971	0.9916	0.9696	0.8971	0.7274	0.5326	0.6017	0.8713	0.9833	0.9974	0.9991	(94)
Useful gains	533.3101	625.3102	712.9399	792.9878	796.4538	639.2598	445.5128	461.2053	601.3886	585.9066	523.2643	502.0827	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1871.2249	1808.1873	1632.3411	1353.7768	1040.1697	694.0590	454.1047	476.8491	748.1904	1139.9501	1529.2370	1859.8861	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	995.4086	794.8934	684.0345	403.7681	181.3246	0.0000	0.0000	0.0000	0.0000	412.2084	724.3003	1010.2058	(98)
Space heating												5206.1436	(98)
Space heating per m2											(98) / (4) =	46.2933	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8329	0.9040	0.8706	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	959.1477	819.5095	808.6942	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1132.5131	1081.0400	1002.8657	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	124.8231	194.5787	144.4636	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												463.8655	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	31.2058	48.6447	36.1159	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												115.9664	(107)
Space cooling per m2												1.0312	(108)
Energy for space heating												46.2933	(99)
Energy for space cooling												1.0312	(108)
Total												47.3245	(109)
Target Fabric Energy Efficiency (TFEE)												54.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6000	
Infiltration rate				0.3674	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3569	0.3314	0.3399	0.3229	0.3229	0.3144	0.3059	0.2974	0.2889	0.3144	0.2974	0.3144	(22b)
Effective ac	0.5637	0.5549	0.5578	0.5521	0.5521	0.5494	0.5468	0.5442	0.5417	0.5494	0.5442	0.5494	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1380	53.2955	53.5694	53.0286	53.0286	52.7685	52.5154	52.2693	52.0300	52.7685	52.2693	52.7685	(38)
Heat transfer coeff	128.0031	127.1606	127.4345	126.8936	126.8936	126.6336	126.3805	126.1343	125.8951	126.6336	126.1343	126.6336	(39)
Average = Sum(39)m / 12 =												126.7358	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1382	1.1307	1.1332	1.1283	1.1283	1.1260	1.1238	1.1216	1.1195	1.1260	1.1216	1.1260	(40)
HLP (average)												1.1269	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
									Total per year (kWh/year) = Sum(64)m =			1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Southwest	2.1600	45.1778	0.4600	0.0000	0.7700	34.5643	(79)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

Solar gains	172.5262	263.4248	399.2440	558.2548	646.2915	721.4972	680.0486	597.8751	478.0043	324.4547	208.8025	143.3414	(83)
Total gains	841.2885	926.8105	1036.2080	1154.2999	1200.1820	1238.0655	1175.1703	1102.6242	1006.6496	894.2508	824.1900	793.4666	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4191	33.6405	33.5682	33.7113	33.7113	33.7805	33.8482	33.9142	33.9787	33.7805	33.9142	33.7805	
alpha	3.2279	3.2427	3.2379	3.2474	3.2474	3.2520	3.2565	3.2609	3.2652	3.2520	3.2609	3.2520	
util living area	0.9664	0.9537	0.9198	0.8452	0.7222	0.5362	0.4047	0.4278	0.6677	0.8664	0.9453	0.9706	(86)
MIT	19.3726	19.5460	19.9147	20.3675	20.7230	20.9242	20.9773	20.9735	20.8413	20.4230	19.8557	19.3563	(87)
Th 2	19.9698	19.9758	19.9738	19.9778	19.9778	19.9796	19.9815	19.9832	19.9850	19.9796	19.9832	19.9796	(88)
util rest of house	0.9601	0.9452	0.9046	0.8155	0.6684	0.4549	0.3051	0.3238	0.5910	0.8332	0.9333	0.9650	(89)
MIT 2	17.8280	18.0803	18.6043	19.2340	19.6967	19.9232	19.9708	19.9706	19.8498	19.3252	18.5344	17.8112	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3048	18.5328	19.0088	19.5840	20.0135	20.2323	20.2815	20.2802	20.1559	19.6641	18.9423	18.2882	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1548	18.3828	18.8588	19.4340	19.8635	20.0823	20.1315	20.1302	20.0059	19.5141	18.7923	18.1382	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9448	0.9275	0.8839	0.7970	0.6617	0.4635	0.3203	0.3394	0.5928	0.8149	0.9147	0.9508	(94)
Useful gains	794.8280	859.6143	915.9187	920.0338	794.1904	573.8421	376.3558	374.2346	596.6921	728.7440	753.9222	754.4329	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1696.6603	1663.6199	1511.2258	1260.5551	934.3859	605.5963	383.1249	382.2108	667.9859	1027.5219	1373.8954	1663.7402	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	670.9632	540.2918	442.9084	245.1754	104.3054	0.0000	0.0000	0.0000	0.0000	222.2907	446.3807	676.5246	(98)
Space heating												3348.8404	(98)
RHI space heating demand												3349	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6000	
Infiltration rate				0.3674	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4333	0.4248	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5902	0.5867	0.5699	0.5667	0.5521	0.5521	0.5494	0.5578	0.5667	0.5731	0.5797	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.0400	56.6898	56.3466	54.7344	54.4327	53.0286	53.0286	52.7685	53.5694	54.4327	55.0430	55.6809	(38)
Heat transfer coeff	130.9051	130.5549	130.2116	128.5994	128.2978	126.8936	126.8936	126.6336	127.4345	128.2978	128.9080	129.5459	(39)
Average = Sum(39)m / 12 =												128.5980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1640	1.1609	1.1578	1.1435	1.1408	1.1283	1.1283	1.1260	1.1332	1.1408	1.1463	1.1519	(40)
HLP (average)												1.1435	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	807.3453	911.0702	1006.8978	1106.7005	1173.7828	1153.1046	1100.0150	1024.8835	946.7796	851.8943	783.4914	767.3579	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6782	32.7659	32.8523	33.2641	33.3423	33.7113	33.7113	33.7805	33.5682	33.3423	33.1845	33.0211	
alpha	3.1785	3.1844	3.1902	3.2176	3.2228	3.2474	3.2474	3.2520	3.2379	3.2228	3.2123	3.2014	
util living area													
	0.9730	0.9592	0.9323	0.8735	0.7694	0.6181	0.4783	0.5254	0.7351	0.8998	0.9593	0.9767	(86)
MIT	19.1867	19.4087	19.7688	20.2325	20.6220	20.8701	20.9579	20.9424	20.7605	20.2601	19.6464	19.1463	(87)
Th 2	19.9489	19.9514	19.9539	19.9655	19.9676	19.9778	19.9778	19.9796	19.9738	19.9676	19.9632	19.9586	(88)
util rest of house													
	0.9679	0.9517	0.9194	0.8485	0.7232	0.5425	0.3783	0.4244	0.6679	0.8747	0.9504	0.9723	(89)
MIT 2	17.5462	17.8675	18.3847	19.0425	19.5633	19.8689	19.9538	19.9444	19.7516	19.0958	18.2223	17.4939	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.0527	18.3433	18.8120	19.4099	19.8901	20.1780	20.2638	20.2525	20.0631	19.4553	18.6619	18.0041	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9027	18.1933	18.6620	19.2599	19.7401	20.0280	20.1138	20.1025	19.9131	19.3053	18.5119	17.8541	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Utilisation	0.9541	0.9346	0.8990	0.8282	0.7118	0.5465	0.3922	0.4372	0.6634	0.8545	0.9336	0.9597	(94)
Useful gains	770.2717	851.4528	905.1663	916.6124	835.4668	630.1754	431.4466	448.1183	628.1377	727.9668	731.4288	736.4522	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1780.6619	1735.5078	1583.6323	1332.2736	1031.5330	688.7777	445.8809	468.8618	740.7905	1116.8672	1471.0910	1768.8307	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	751.7303	594.0850	504.7787	299.2761	145.8732	0.0000	0.0000	0.0000	0.0000	289.3419	532.5567	768.0896	(98)
Space heating												3885.7316	(98)
Space heating per m2											(98) / (4) =	34.5521	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4293.6261	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	751.7303	594.0850	504.7787	299.2761	145.8732	0.0000	0.0000	0.0000	0.0000	289.3419	532.5567	768.0896	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	830.6412	656.4475	557.7665	330.6918	161.1859	0.0000	0.0000	0.0000	0.0000	319.7148	588.4605	848.7178	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8649	89.8104	89.6961	89.4363	88.9104	87.3000	87.3000	87.3000	87.3000	89.3853	89.7359	89.8906	(217)
Fuel for water heating, kWh/month	199.7870	175.2795	182.1455	160.7332	156.2311	138.9421	130.3772	147.2980	148.3736	166.9165	179.5922	193.9108	(219)
Water heating fuel used												1979.5867	(219)
Annual totals kWh/year													
Space heating fuel - main system												4293.6261	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5590.2580	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4293.6261	3.4800	149.4182	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.5867	3.4800	68.8896	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			248.2261	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6621	(257)
SAP value		90.7636	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4293.6261	0.2160	927.4232	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.5867	0.2160	427.5907	(264)
Space and water heating			1355.0140	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)

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Energy for lighting	460.6022	0.5190	239.0525 (268)
Energy saving/generation technologies			
PV Unit	-1218.5571	0.5190	-632.4311 (269)
Total kg/year			1000.5604 (272)
CO2 emissions per m2			8.9000 (273)
EI value			91.4851
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6000	
Infiltration rate			0.3674	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3569	0.3314	0.3399	0.3229	0.3229	0.3144	0.3059	0.2974	0.2889	0.3144	0.2974	0.3144	(22b)
Effective ac	0.5637	0.5549	0.5578	0.5521	0.5521	0.5494	0.5468	0.5442	0.5417	0.5494	0.5442	0.5494	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.1278	(36)
Total fabric heat loss					(33) + (36) =		73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1380	53.2955	53.5694	53.0286	53.0286	52.7685	52.5154	52.2693	52.0300	52.7685	52.2693	52.7685	(38)
Heat transfer coeff	128.0031	127.1606	127.4345	126.8936	126.8936	126.6336	126.3805	126.1343	125.8951	126.6336	126.1343	126.6336	(39)
Average = Sum(39)m / 12 =												126.7358	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1382	1.1307	1.1332	1.1283	1.1283	1.1260	1.1238	1.1216	1.1195	1.1260	1.1216	1.1260	(40)
HLP (average)												1.1269	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Southwest	2.1600	45.1778	0.4600	0.0000	0.7700	34.5643	(79)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	172.5262	263.4248	399.2440	558.2548	646.2915	721.4972	680.0486	597.8751	478.0043	324.4547	208.8025	143.3414	(83)
Total gains	841.2885	926.8105	1036.2080	1154.2999	1200.1820	1238.0655	1175.1703	1102.6242	1006.6496	894.2508	824.1900	793.4666	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4191	33.6405	33.5682	33.7113	33.7113	33.7805	33.8482	33.9142	33.9787	33.7805	33.9142	33.7805	
alpha	3.2279	3.2427	3.2379	3.2474	3.2474	3.2520	3.2565	3.2609	3.2652	3.2520	3.2609	3.2520	
util living area	0.9664	0.9537	0.9198	0.8452	0.7222	0.5362	0.4047	0.4278	0.6677	0.8664	0.9453	0.9706	(86)
MIT	19.3726	19.5460	19.9147	20.3675	20.7230	20.9242	20.9773	20.9735	20.8413	20.4230	19.8557	19.3563	(87)
Th 2	19.9698	19.9758	19.9738	19.9778	19.9778	19.9796	19.9815	19.9832	19.9850	19.9796	19.9832	19.9796	(88)
util rest of house	0.9601	0.9452	0.9046	0.8155	0.6684	0.4549	0.3051	0.3238	0.5910	0.8332	0.9333	0.9650	(89)
MIT 2	17.8280	18.0803	18.6043	19.2340	19.6967	19.9232	19.9708	19.9706	19.8498	19.3252	18.5344	17.8112	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3048	18.5328	19.0088	19.5840	20.0135	20.2323	20.2815	20.2802	20.1559	19.6641	18.9423	18.2882	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1548	18.3828	18.8588	19.4340	19.8635	20.0823	20.1315	20.1302	20.0059	19.5141	18.7923	18.1382	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9448	0.9275	0.8839	0.7970	0.6617	0.4635	0.3203	0.3394	0.5928	0.8149	0.9147	0.9508	(94)
Useful gains	794.8280	859.6143	915.9187	920.0338	794.1904	573.8421	376.3558	374.2346	596.6921	728.7440	753.9222	754.4329	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1696.6603	1663.6199	1511.2258	1260.5551	934.3859	605.5963	383.1249	382.2108	667.9859	1027.5219	1373.8954	1663.7402	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.9632	540.2918	442.9084	245.1754	104.3054	0.0000	0.0000	0.0000	0.0000	222.2907	446.3807	676.5246	(98)
Space heating												3348.8404	(98)
Space heating per m2											(98) / (4) =	29.7781	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3700.3761	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.9632	540.2918	442.9084	245.1754	104.3054	0.0000	0.0000	0.0000	0.0000	222.2907	446.3807	676.5246	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.3958	597.0075	489.4016	270.9120	115.2546	0.0000	0.0000	0.0000	0.0000	245.6251	493.2383	747.5410	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8051	89.7577	89.6148	89.2903	88.6442	87.3000	87.3000	87.3000	87.3000	89.1870	89.6285	89.8255	(217)
Fuel for water heating, kWh/month	199.9201	175.3824	182.3106	160.9960	156.7001	138.9421	130.3772	147.2980	148.3736	167.2876	179.8073	194.0513	(219)
Water heating fuel used												1981.4465	(219)
Annual totals kWh/year													
Space heating fuel - main system												3700.3761	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4848.4476	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3700.3761	10.2300	378.5485	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.4465	10.2300	202.7020	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			378.2352	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3700.3761	0.2160	799.2812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.4465	0.2160	427.9924	(264)
Space and water heating			1227.2737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			794.7521	(272)

13a. Primary energy - Individual heating systems including micro-CHP

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3700.3761	1.2200	4514.4588	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.4465	1.2200	2417.3647	(264)
Space and water heating			6931.8235	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4373.3625	(272)
Primary energy kWh/m2/year			38.8882	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (24.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	A 92	A 93
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£684	£579	£105
Space heating	£509	£509	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£378	£291	£87
Total cost of uses	£378	£291	£87
Delivered energy	43 kWh/m²	34 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	39 kWh/m²	29 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6000	
Infiltration rate				0.3674	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4333	0.4248	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5902	0.5867	0.5699	0.5667	0.5521	0.5521	0.5494	0.5578	0.5667	0.5731	0.5797	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.1278	(36)
Total fabric heat loss					(33) + (36) =		73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.0400	56.6898	56.3466	54.7344	54.4327	53.0286	53.0286	52.7685	53.5694	54.4327	55.0430	55.6809	(38)
Heat transfer coeff	130.9051	130.5549	130.2116	128.5994	128.2978	126.8936	126.8936	126.6336	127.4345	128.2978	128.9080	129.5459	(39)
Average = Sum(39)m / 12 =												128.5980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1640	1.1609	1.1578	1.1435	1.1408	1.1283	1.1283	1.1260	1.1332	1.1408	1.1463	1.1519	(40)
HLP (average)												1.1435	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)

Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1079.5246	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1813.6014	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.1369	(H8)
Utilisation factor	0.5850	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	101.3843	(H14)
Volume ratio Veff/V	0.7398	(H15)
Solar storage volume factor	0.9397	(H16)
Solar input	-876.7033	(H17)

Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
								Solar input (sum of months) = Sum(63)m =				-876.7033	(63)
Output from w/h													
	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
								Total per year (kWh/year) = Sum(64)m =				886.4316	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	807.3453	911.0702	1006.8978	1106.7005	1173.7828	1153.1046	1100.0150	1024.8835	946.7796	851.8943	783.4914	767.3579	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.6782	32.7659	32.8523	33.2641	33.3423	33.7113	33.7113	33.7805	33.5682	33.3423	33.1845	33.0211
alpha	3.1785	3.1844	3.1902	3.2176	3.2228	3.2474	3.2474	3.2520	3.2379	3.2228	3.2123	3.2014
util living area												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9730	0.9592	0.9323	0.8735	0.7694	0.6181	0.4783	0.5254	0.7351	0.8998	0.9593	0.9767	(86)
MIT	19.1867	19.4087	19.7688	20.2325	20.6220	20.8701	20.9579	20.9424	20.7605	20.2601	19.6464	19.1463	(87)
Th 2	19.9489	19.9514	19.9539	19.9655	19.9676	19.9778	19.9778	19.9796	19.9738	19.9676	19.9632	19.9586	(88)
util rest of house	0.9679	0.9517	0.9194	0.8485	0.7232	0.5425	0.3783	0.4244	0.6679	0.8747	0.9504	0.9723	(89)
MIT 2	17.5462	17.8675	18.3847	19.0425	19.5633	19.8689	19.9538	19.9444	19.7516	19.0958	18.2223	17.4939	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0527	18.3433	18.8120	19.4099	19.8901	20.1780	20.2638	20.2525	20.0631	19.4553	18.6619	18.0041	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9027	18.1933	18.6620	19.2599	19.7401	20.0280	20.1138	20.1025	19.9131	19.3053	18.5119	17.8541	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9541	0.9346	0.8990	0.8282	0.7118	0.5465	0.3922	0.4372	0.6634	0.8545	0.9336	0.9597	(94)
Useful gains	770.2717	851.4528	905.1663	916.6124	835.4668	630.1754	431.4466	448.1183	628.1377	727.9668	731.4288	736.4522	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1780.6619	1735.5078	1583.6323	1332.2736	1031.5330	688.7777	445.8809	468.8618	740.7905	1116.8672	1471.0910	1768.8307	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	751.7303	594.0850	504.7787	299.2761	145.8732	0.0000	0.0000	0.0000	0.0000	289.3419	532.5567	768.0896	(98)
Space heating												3885.7316	(98)
Space heating per m2											(98) / (4) =	34.5521	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4293.6261	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	751.7303	594.0850	504.7787	299.2761	145.8732	0.0000	0.0000	0.0000	0.0000	289.3419	532.5567	768.0896	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	830.6412	656.4475	557.7665	330.6918	161.1859	0.0000	0.0000	0.0000	0.0000	319.7148	588.4605	848.7178	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9391	89.9652	89.9955	90.0526	90.1144	87.3000	87.3000	87.3000	87.3000	89.6876	89.8498	89.9522	(217)
Fuel for water heating, kWh/month	171.3558	127.8229	101.2561	52.1059	21.3939	4.2204	0.0000	31.1465	57.4037	105.8859	145.8030	170.1271	(219)
Water heating fuel used												988.5211	(219)
Annual totals kWh/year													
Space heating fuel - main system												4293.6261	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4649.1923	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4293.6261	3.4800	149.4182	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.5211	3.4800	34.4005	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			220.3320	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5877	(257)
SAP value		91.8016	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4293.6261	0.2160	927.4232	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.5211	0.2160	213.5205	(264)
Space and water heating			1140.9438	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			812.4402	(272)
CO2 emissions per m2			7.2200	(273)
EI value			93.0861	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6000	
Infiltration rate		0.3674	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3399	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3569	0.3314	0.3399	0.3229	0.3229	0.3144	0.3059	0.2974	0.2889	0.3144	0.2974	0.3144	(22b)
Effective ac	0.5637	0.5549	0.5578	0.5521	0.5521	0.5494	0.5468	0.5442	0.5417	0.5494	0.5442	0.5494	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1380	53.2955	53.5694	53.0286	53.0286	52.7685	52.5154	52.2693	52.0300	52.7685	52.2693	52.7685	(38)
Heat transfer coeff	128.0031	127.1606	127.4345	126.8936	126.8936	126.6336	126.3805	126.1343	125.8951	126.6336	126.1343	126.6336	(39)
Average = Sum(39)m / 12 =												126.7358	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1382	1.1307	1.1332	1.1283	1.1283	1.1260	1.1238	1.1216	1.1195	1.1260	1.1216	1.1260	(40)
HLP (average)												1.1269	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
										Solar input (sum of months) = Sum(63)m =		-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
										Total per year (kWh/year) = Sum(64)m =		856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Southwest	2.1600	45.1778	0.4600	0.0000	0.7700	34.5643	(79)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

Solar gains	172.5262	263.4248	399.2440	558.2548	646.2915	721.4972	680.0486	597.8751	478.0043	324.4547	208.8025	143.3414	(83)
Total gains	841.2885	926.8105	1036.2080	1154.2999	1200.1820	1238.0655	1175.1703	1102.6242	1006.6496	894.2508	824.1900	793.4666	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4191	33.6405	33.5682	33.7113	33.7113	33.7805	33.8482	33.9142	33.9787	33.7805	33.9142	33.7805	
alpha	3.2279	3.2427	3.2379	3.2474	3.2474	3.2520	3.2565	3.2609	3.2652	3.2520	3.2609	3.2520	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9664	0.9537	0.9198	0.8452	0.7222	0.5362	0.4047	0.4278	0.6677	0.8664	0.9453	0.9706	(86)
MIT	19.3726	19.5460	19.9147	20.3675	20.7230	20.9242	20.9773	20.9735	20.8413	20.4230	19.8557	19.3563	(87)
Th 2	19.9698	19.9758	19.9738	19.9778	19.9778	19.9796	19.9815	19.9832	19.9850	19.9796	19.9832	19.9796	(88)
util rest of house	0.9601	0.9452	0.9046	0.8155	0.6684	0.4549	0.3051	0.3238	0.5910	0.8332	0.9333	0.9650	(89)
MIT 2	17.8280	18.0803	18.6043	19.2340	19.6967	19.9232	19.9708	19.9706	19.8498	19.3252	18.5344	17.8112	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3048	18.5328	19.0088	19.5840	20.0135	20.2323	20.2815	20.2802	20.1559	19.6641	18.9423	18.2882	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1548	18.3828	18.8588	19.4340	19.8635	20.0823	20.1315	20.1302	20.0059	19.5141	18.7923	18.1382	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9448	0.9275	0.8839	0.7970	0.6617	0.4635	0.3203	0.3394	0.5928	0.8149	0.9147	0.9508	(94)
Useful gains	794.8280	859.6143	915.9187	920.0338	794.1904	573.8421	376.3558	374.2346	596.6921	728.7440	753.9222	754.4329	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1696.6603	1663.6199	1511.2258	1260.5551	934.3859	605.5963	383.1249	382.2108	667.9859	1027.5219	1373.8954	1663.7402	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.9632	540.2918	442.9084	245.1754	104.3054	0.0000	0.0000	0.0000	0.0000	222.2907	446.3807	676.5246	(98)
Space heating												3348.8404	(98)
Space heating per m2											(98) / (4) =	29.7781	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3700.3761	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.9632	540.2918	442.9084	245.1754	104.3054	0.0000	0.0000	0.0000	0.0000	222.2907	446.3807	676.5246	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.3958	597.0075	489.4016	270.9120	115.2546	0.0000	0.0000	0.0000	0.0000	245.6251	493.2383	747.5410	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8987	89.9212	89.9402	89.9832	89.8927	87.3000	87.3000	87.3000	87.3000	89.5483	89.7759	89.9025	(217)
Fuel for water heating, kWh/month	166.5867	127.9732	100.7314	50.6290	26.2182	0.0000	0.0000	23.6468	51.5633	101.3617	140.2800	166.6475	(219)
Water heating fuel used												955.6378	(219)
Annual totals kWh/year													
Space heating fuel - main system												3700.3761	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3872.6389	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3700.3761	10.2300	378.5485	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.6378	10.2300	97.7617	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			291.6549	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3700.3761	0.2160	799.2812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.6378	0.2160	206.4178	(264)
Space and water heating			1005.6990	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			599.1274	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3700.3761	1.2200	4514.4588	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.6378	1.2200	1165.8781	(264)
Space and water heating			5680.3369	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3275.3759	(272)
Primary energy kWh/m2/year			29.1248	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		384.18 (P1)
Transmission heat loss coefficient		73.87 (37)
Summer heat loss coefficient		458.04 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	1.00	1.000	1.000	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	5.8100	119.9223	0.4600	0.0000	0.9000	288.4540
South West	2.1600	119.9223	0.4600	0.0000	0.9000	107.2394
North West	2.1700	98.8453	0.4600	0.0000	0.9000	88.8006
North West	5.4600	98.8453	0.4600	0.0000	0.9000	223.4338
North West	0.6500	156.6480	0.6300	0.7000	1.0000	40.4128
total:						748.3406

	Jun	Jul	Aug	
Solar gains	796	748	657	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1310	1240	1159	(P5)
Summer gain/loss ratio	2.86	2.71	2.53	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.90	21.65	21.37	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-320	**Issued on Date**	20/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	9, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	91 B	**DER**	10.52	**TER**	17.50
Environmental	91 B	**% DER<TER**	39.90		
CO_2 Emissions (t/year)	0.81	**DFEE**	47.53	**TFEE**	55.43
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.26		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.50 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.52 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.63 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 2.16 m², No overhang
Windows facing South East: 5.81 m², No overhang
Windows facing North West: 7.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			4.6300	
Infiltration rate			0.3689	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4351	0.4266	0.4181	0.3754	0.3669	0.3242	0.3242	0.3157	0.3413	0.3669	0.3839	0.4010	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5498	0.5582	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1138	56.7608	56.4147	54.7893	54.4852	53.0695	53.0695	52.8074	53.6148	54.4852	55.1004	55.7436	(38)
Heat transfer coeff	130.9788	130.6258	130.2797	128.6543	128.3502	126.9346	126.9346	126.6724	127.4798	128.3502	128.9654	129.6086	(39)
Average = Sum(39)m / 12 =												128.6529	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1647	1.1615	1.1585	1.1440	1.1413	1.1287	1.1287	1.1264	1.1336	1.1413	1.1468	1.1525	(40)
HLP (average)												1.1440	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	567.2907	663.1231	765.4114	884.2708	974.4079	970.4461	920.6838	835.7323	739.4355	631.0854	556.4269	534.6699	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6598	32.7481	32.8351	33.2499	33.3287	33.7004	33.7004	33.7702	33.5563	33.3287	33.1697	33.0051	
alpha	3.1773	3.1832	3.1890	3.2167	3.2219	3.2467	3.2467	3.2513	3.2371	3.2219	3.2113	3.2003	
util living area	0.9898	0.9825	0.9659	0.9229	0.8340	0.6927	0.5531	0.6139	0.8255	0.9507	0.9838	0.9915	(86)
MIT	18.8954	19.1194	19.5091	20.0356	20.5036	20.8167	20.9356	20.9089	20.6485	20.0425	19.3799	18.8603	(87)
Th 2	19.9484	19.9509	19.9534	19.9651	19.9672	19.9775	19.9775	19.9793	19.9735	19.9672	19.9628	19.9582	(88)
util rest of house	0.9877	0.9789	0.9586	0.9054	0.7946	0.6175	0.4440	0.5058	0.7688	0.9363	0.9799	0.9898	(89)
MIT 2	17.1249	17.4520	18.0181	18.7771	19.4198	19.8179	19.9393	19.9205	19.6286	18.8003	17.8408	17.0795	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6715	17.9668	18.4784	19.1656	19.7544	20.1263	20.2469	20.2257	19.9435	19.1838	18.3160	17.6293	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5215	17.8168	18.3284	19.0156	19.6044	19.9763	20.0969	20.0757	19.7935	19.0338	18.1660	17.4793	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9804	0.9683	0.9429	0.8850	0.7783	0.6174	0.4576	0.5169	0.7568	0.9183	0.9698	0.9835	(94)
Useful gains	556.1837	642.1086	721.7239	782.5624	758.3819	599.2019	421.3406	432.0312	559.6292	579.5406	539.6190	525.8625	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1731.7355	1687.2647	1541.0025	1301.4200	1014.5289	682.4353	443.8742	465.6058	725.8055	1082.4827	1427.1276	1721.1115	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	874.6105	702.3449	609.5433	373.5774	190.5734	0.0000	0.0000	0.0000	0.0000	374.1889	639.0062	889.2653	(98)
Space heating												4653.1099	(98)
Space heating per m2											(98) / (4) =	41.3757	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5141.5579	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	874.6105	702.3449	609.5433	373.5774	190.5734	0.0000	0.0000	0.0000	0.0000	374.1889	639.0062	889.2653	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	966.4205	776.0717	673.5285	412.7927	210.5783	0.0000	0.0000	0.0000	0.0000	413.4684	706.0842	982.6135	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9385	89.8967	89.8042	89.5875	89.1227	87.3000	87.3000	87.3000	87.3000	89.5641	89.8368	89.9596	(217)
Fuel for water heating, kWh/month	199.6236	175.1113	181.9262	160.4619	155.8588	138.9421	130.3772	147.2980	148.3736	166.5832	179.3905	193.7620	(219)
Water heating fuel used												1977.7084	(219)
Annual totals kWh/year													
Space heating fuel - main system												5141.5579	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6436.3114	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5141.5579	0.2160	1110.5765	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.7084	0.2160	427.1850	(264)
Space and water heating			1537.7615	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1183.3079	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.5200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.5200	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		26.6746	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.6746	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616 (1b) - (3b)	
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082 (1c) - (3c)	
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.3375	(36)
Total fabric heat loss	(33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(75)
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	103.3119	188.6894	292.0949	419.0382	521.6809	540.9740	511.9541	431.8184	335.4767	217.6728	126.0548	86.9202	(83)
Total gains	563.9046	646.8781	733.9021	834.2355	908.9623	901.6908	856.1228	783.3258	701.5354	610.5730	549.6111	533.7699	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9991	0.9981	0.9944	0.9785	0.9204	0.7761	0.6079	0.6772	0.9080	0.9891	0.9982	0.9994	(86)
MIT	19.6948	19.8321	20.0767	20.4200	20.7328	20.9288	20.9843	20.9732	20.8208	20.4219	20.0027	19.6771	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9988	0.9974	0.9923	0.9696	0.8860	0.6897	0.4820	0.5511	0.8540	0.9832	0.9975	0.9991	(89)
MIT 2	18.2248	18.4276	18.7864	19.2912	19.7216	19.9591	20.0034	19.9997	19.8472	19.3003	18.6869	18.2066	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6787	18.8612	19.1847	19.6397	20.0338	20.2585	20.3062	20.3002	20.1478	19.6466	19.0931	18.6606	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6787	18.8612	19.1847	19.6397	20.0338	20.2585	20.3062	20.3002	20.1478	19.6466	19.0931	18.6606	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9963	0.9900	0.9655	0.8875	0.7134	0.5212	0.5902	0.8634	0.9803	0.9964	0.9987	(94)
Useful gains	562.9303	644.4677	726.5415	805.4136	806.6710	643.2348	446.2508	462.3506	605.6710	598.5273	547.6520	533.0782	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1825.6037	1767.1633	1600.7519	1336.0450	1033.9554	693.1953	454.0330	476.6742	744.5293	1122.3851	1496.0887	1814.1544	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	939.4290	754.4514	650.4125	382.0546	169.0996	0.0000	0.0000	0.0000	0.0000	389.7502	682.8744	953.1207	(98)
Space heating												4921.1924	(98)
Space heating per m2											(98) / (4) =	43.7595	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5268.9427	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	939.4290	754.4514	650.4125	382.0546	169.0996	0.0000	0.0000	0.0000	0.0000	389.7502	682.8744	953.1207	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1005.8127	807.7638	696.3731	409.0520	181.0488	0.0000	0.0000	0.0000	0.0000	417.2914	731.1289	1020.4718	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3206	88.1629	87.8006	86.9107	84.9877	80.3000	80.3000	80.3000	80.3000	86.8692	87.9258	88.3841	(217)
Fuel for water heating, kWh/month													
	244.9530	216.2750	228.0410	206.1064	204.0625	190.2188	182.2441	203.1594	205.4031	214.2035	223.8329	238.8728	(219)
Water heating fuel used												2557.3724	(219)
Annual totals kWh/year													
Space heating fuel - main system												5268.9427	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8361.9173	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5268.9427	0.2160	1138.0916	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2557.3724	0.2160	552.3924	(264)
Space and water heating			1690.4841	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1968.4616	(272)
Emissions per m2 for space and water heating			15.0319	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0319 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.5000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4351	0.4266	0.4181	0.3754	0.3669	0.3242	0.3242	0.3157	0.3413	0.3669	0.3839	0.4010	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5498	0.5582	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1138	56.7608	56.4147	54.7893	54.4852	53.0695	53.0695	52.8074	53.6148	54.4852	55.1004	55.7436	(38)
Heat transfer coeff	130.9788	130.6258	130.2797	128.6543	128.3502	126.9346	126.9346	126.6724	127.4798	128.3502	128.9654	129.6086	(39)
Average = Sum(39)m / 12 =												128.6529	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1647	1.1615	1.1585	1.1440	1.1413	1.1287	1.1287	1.1264	1.1336	1.1413	1.1468	1.1525	(40)
HLP (average)												1.1440	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	532.8598	629.5417	733.5939	854.8521	946.5502	944.7837	896.8839	809.5423	712.3935	601.5607	524.0996	501.0849	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1132	32.2000	32.2855	32.6934	32.7709	33.1363	33.1363	33.2049	32.9946	32.7709	32.6145	32.4527	
alpha	3.1409	3.1467	3.1524	3.1796	3.1847	3.2091	3.2091	3.2137	3.1996	3.1847	3.1743	3.1635	
util living area	0.9910	0.9841	0.9684	0.9270	0.8408	0.7020	0.5632	0.6263	0.8352	0.9550	0.9856	0.9926	(86)
MIT	18.8278	19.0561	19.4542	19.9935	20.4757	20.8028	20.9294	20.8998	20.6240	19.9979	19.3209	18.7929	(87)
Th 2	19.9484	19.9509	19.9534	19.9651	19.9672	19.9775	19.9775	19.9793	19.9735	19.9672	19.9628	19.9582	(88)
util rest of house	0.9892	0.9809	0.9616	0.9104	0.8026	0.6277	0.4536	0.5182	0.7805	0.9417	0.9822	0.9911	(89)
MIT 2	17.9552	18.1839	18.5799	19.1153	19.5700	19.8590	19.9485	19.9345	19.7189	19.1293	18.4573	17.9275	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.2246	18.4532	18.8498	19.3864	19.8496	20.1504	20.2513	20.2325	19.9984	19.3975	18.7240	18.1947	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2246	18.4532	18.8498	19.3864	19.8496	20.1504	20.2513	20.2325	19.9984	19.3975	18.7240	18.1947	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9851	0.9748	0.9524	0.8992	0.7976	0.6414	0.4848	0.5472	0.7820	0.9322	0.9766	0.9876	(94)
Useful gains	524.9015	613.6491	698.6914	768.6406	754.9448	606.0110	434.7718	442.9698	557.1159	560.8038	511.8187	494.8599	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1823.8256	1770.3988	1608.9348	1349.1230	1046.0028	704.5366	463.4776	485.4717	751.9232	1129.1578	1499.0879	1813.8303	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	966.3995	777.3358	677.2211	417.9474	216.5471	0.0000	0.0000	0.0000	0.0000	422.8554	710.8338	981.3140 (98)
Space heating												5170.4541 (98)
Space heating per m2											(98) / (4) =	45.9759 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1193.1848	939.3157	962.7102	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7676	0.8335	0.7957	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	915.8967	782.9632	766.0505	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1209.6178	1151.6762	1053.1801	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	211.4792	274.3225	213.6245	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												699.4261	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	52.8698	68.5806	53.4061	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												174.8565	(107)
Space cooling per m2												1.5548	(108)
Energy for space heating												45.9759	(99)
Energy for space cooling												1.5548	(108)
Total												47.5308	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400	(1b)	x 2.5400	(2b) =	111.8616	(1b) - (3b)
First floor	39.7800	(1c)	x 2.6900	(2c) =	107.0082	(1c) - (3c)
Second floor	28.6400	(1d)	x 2.5200	(2d) =	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288 (42)
Average daily hot water use (litres/day)	101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(75)
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	103.3119	188.6894	292.0949	419.0382	521.6809	540.9740	511.9541	431.8184	335.4767	217.6728	126.0548	86.9202	(83)
Total gains	517.1063	600.9250	689.7043	792.5339	869.5044	865.1085	821.3946	745.5277	662.1988	568.6565	504.9059	487.8133	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9994	0.9986	0.9958	0.9827	0.9315	0.7960	0.6296	0.7034	0.9239	0.9920	0.9988	0.9996	(86)
MIT	19.6557	19.7939	20.0406	20.3884	20.7103	20.9194	20.9815	20.9681	20.7995	20.3884	19.9654	19.6386	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9992	0.9981	0.9942	0.9752	0.9004	0.7115	0.5012	0.5761	0.8759	0.9876	0.9983	0.9994	(89)
MIT 2	18.7417	18.8820	19.1302	19.4844	19.7905	19.9697	20.0045	20.0016	19.8812	19.4891	19.0642	18.7333	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	19.0239	19.1635	19.4113	19.7635	20.0745	20.2629	20.3061	20.3000	20.1647	19.7667	19.3424	19.0128	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0239	19.1635	19.4113	19.7635	20.0745	20.2629	20.3061	20.3000	20.1647	19.7667	19.3424	19.0128	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9976	0.9929	0.9730	0.9032	0.7353	0.5415	0.6160	0.8853	0.9862	0.9978	0.9992	(94)
Useful gains	516.5739	599.4775	684.8270	771.1525	785.3796	636.1158	444.7628	459.2411	586.2518	560.7948	503.8032	487.4464	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1869.4403	1805.4340	1629.3377	1351.4500	1038.9998	693.7421	454.0252	476.6463	746.6150	1137.2930	1527.1874	1858.3409	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1006.5326	810.4028	702.7160	417.8142	188.6934	0.0000	0.0000	0.0000	0.0000	428.9146	736.8366	1019.9455	(98)
Space heating												5311.8557	(98)
Space heating per m2											(98) / (4) =	47.2333	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8267	0.8989	0.8612	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	952.0296	814.8950	799.9667	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1116.4910	1063.4419	978.3578	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	118.4122	184.9189	132.7230	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												436.0541	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	29.6030	46.2297	33.1807	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												109.0135	(107)
Space cooling per m2												0.9694	(108)
Energy for space heating												47.2333	(99)
Energy for space cooling												0.9694	(108)
Total												48.2026	(109)
Target Fabric Energy Efficiency (TFEE)												55.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6300	
Infiltration rate				0.3689	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3583	0.3327	0.3413	0.3242	0.3242	0.3157	0.3071	0.2986	0.2901	0.3157	0.2986	0.3157	(22b)
Effective ac	0.5642	0.5554	0.5582	0.5526	0.5526	0.5498	0.5472	0.5446	0.5421	0.5498	0.5446	0.5498	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1881	53.3387	53.6148	53.0695	53.0695	52.8074	52.5522	52.3040	52.0628	52.8074	52.3040	52.8074	(38)
Heat transfer coeff	128.0531	127.2037	127.4798	126.9346	126.9346	126.6724	126.4172	126.1690	125.9279	126.6724	126.1690	126.6724	(39)
Average = Sum(39)m / 12 =												126.7755	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1387	1.1311	1.1336	1.1287	1.1287	1.1264	1.1241	1.1219	1.1198	1.1264	1.1219	1.1264	(40)
HLP (average)												1.1273	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)
Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(75)
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

Solar gains	149.1455	232.8408	365.6022	530.0878	627.7840	706.8796	663.8719	573.7552	444.4674	290.4875	181.6032	123.2124	(83)
Total gains	817.9078	896.2265	1002.5662	1126.1330	1181.6746	1223.4478	1158.9936	1078.5042	973.1127	860.2836	796.9906	773.3376	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4060	33.6291	33.5563	33.7004	33.7004	33.7702	33.8383	33.9049	33.9698	33.7702	33.9049	33.7702	
alpha	3.2271	3.2419	3.2371	3.2467	3.2467	3.2513	3.2559	3.2603	3.2647	3.2513	3.2603	3.2513	
util living area													
	0.9688	0.9575	0.9258	0.8526	0.7287	0.5414	0.4099	0.4363	0.6823	0.8767	0.9497	0.9726	(86)
MIT	19.3449	19.5116	19.8814	20.3467	20.7150	20.9220	20.9764	20.9719	20.8304	20.3957	19.8262	19.3320	(87)
Th 2	19.9694	19.9755	19.9735	19.9775	19.9775	19.9793	19.9812	19.9830	19.9847	19.9793	19.9830	19.9793	(88)
util rest of house													
	0.9629	0.9496	0.9115	0.8237	0.6751	0.4597	0.3093	0.3307	0.6059	0.8452	0.9385	0.9673	(89)
MIT 2	17.7880	18.0314	18.5580	19.2069	19.6875	19.9212	19.9701	19.9695	19.8391	19.2900	18.4928	17.7763	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2687	18.4884	18.9666	19.5588	20.0047	20.2302	20.2808	20.2789	20.1451	19.6314	18.9045	18.2566	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1187	18.3384	18.8166	19.4088	19.8547	20.0802	20.1308	20.1289	19.9951	19.4814	18.7545	18.1066	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9326	0.8911	0.8049	0.6680	0.4682	0.3245	0.3465	0.6068	0.8265	0.9205	0.9536	(94)
Useful gains	775.5212	835.7795	893.3538	906.4266	789.3666	572.8004	376.0962	373.6780	590.4757	710.9923	733.6446	737.4885	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1692.6950	1658.5280	1506.3792	1257.7645	933.5683	605.5137	383.1399	382.1596	666.8022	1023.6892	1369.4982	1660.2457	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	682.3773	552.8870	456.0909	252.9633	107.2861	0.0000	0.0000	0.0000	0.0000	232.6465	457.8146	686.5314	(98)
Space heating												3428.5971	(98)
RHI space heating demand												3429	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6300	
Infiltration rate				0.3689	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4351	0.4266	0.4181	0.3754	0.3669	0.3242	0.3242	0.3157	0.3413	0.3669	0.3839	0.4010	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5498	0.5582	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1138	56.7608	56.4147	54.7893	54.4852	53.0695	53.0695	52.8074	53.6148	54.4852	55.1004	55.7436	(38)
Heat transfer coeff	130.9788	130.6258	130.2797	128.6543	128.3502	126.9346	126.9346	126.6724	127.4798	128.3502	128.9654	129.6086	(39)
Average = Sum(39)m / 12 =												128.6529	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1647	1.1615	1.1585	1.1440	1.1413	1.1287	1.1287	1.1264	1.1336	1.1413	1.1468	1.1525	(40)
HLP (average)												1.1440	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8288 (42)
Average daily hot water use (litres/day)													101.3843 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	787.8277	880.6917	972.9486	1077.4015	1152.6173	1137.2174	1082.5651	1000.5821	914.3166	820.3730	760.6359	750.3170	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6598	32.7481	32.8351	33.2499	33.3287	33.7004	33.7004	33.7702	33.5563	33.3287	33.1697	33.0051	
alpha	3.1773	3.1832	3.1890	3.2167	3.2219	3.2467	3.2467	3.2513	3.2371	3.2219	3.2113	3.2003	
util living area	0.9747	0.9626	0.9377	0.8804	0.7763	0.6243	0.4849	0.5357	0.7490	0.9079	0.9623	0.9781	(86)
MIT	19.1626	19.3737	19.7334	20.2082	20.6106	20.8661	20.9561	20.9390	20.7456	20.2312	19.6201	19.1250	(87)
Th 2	19.9484	19.9509	19.9534	19.9651	19.9672	19.9775	19.9775	19.9793	19.9735	19.9672	19.9628	19.9582	(88)
util rest of house	0.9699	0.9556	0.9256	0.8564	0.7307	0.5486	0.3840	0.4336	0.6829	0.8842	0.9540	0.9739	(89)
MIT 2	17.5113	17.8172	18.3349	19.0099	19.5494	19.8649	19.9525	19.9418	19.7357	19.0571	18.1846	17.4629	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0211	18.2977	18.7667	19.3798	19.8770	20.1740	20.2623	20.2497	20.0475	19.4196	18.6277	17.9760	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8711	18.1477	18.6167	19.2298	19.7270	20.0240	20.1123	20.0997	19.8975	19.2696	18.4777	17.8260	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9566	0.9392	0.9056	0.8359	0.7187	0.5523	0.3979	0.4464	0.6774	0.8641	0.9377	0.9618	(94)
Useful gains	753.6253	827.1458	881.0908	900.5763	828.3849	628.0562	430.7707	446.6134	619.3201	708.8536	713.2428	721.6518	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1777.5249	1730.4959	1578.5614	1328.9770	1030.2728	688.4957	445.8348	468.6456	739.0599	1112.7432	1467.3359	1766.0509	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	761.7813	607.0513	518.9181	308.4485	150.2046	0.0000	0.0000	0.0000	0.0000	300.4939	542.9470	777.0329	(98)
Space heating												3966.8776	(98)
Space heating per m2											(98) / (4) =	35.2737	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4383.2902	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	761.7813	607.0513	518.9181	308.4485	150.2046	0.0000	0.0000	0.0000	0.0000	300.4939	542.9470	777.0329	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	841.7473	670.7749	573.3902	340.8271	165.9720	0.0000	0.0000	0.0000	0.0000	332.0374	599.9414	858.5999	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8717	89.8220	89.7126	89.4576	88.9338	87.3000	87.3000	87.3000	87.3000	89.4126	89.7470	89.8962	(217)
Fuel for water heating, kWh/month	199.7720	175.2568	182.1119	160.6949	156.1900	138.9421	130.3772	147.2980	148.3736	166.8655	179.5698	193.8985	(219)
Water heating fuel used												1979.3505	(219)
Annual totals kWh/year													
Space heating fuel - main system												4383.2902	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5679.6858	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4383.2902	3.4800	152.5385	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3505	3.4800	68.8814	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			251.3382	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6704	(257)
SAP value		90.6478	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4383.2902	0.2160	946.7907	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3505	0.2160	427.5397	(264)
Space and water heating			1374.3304	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy for lighting	460.6022	0.5190	239.0525 (268)
Energy saving/generation technologies			
PV Unit	-1218.5571	0.5190	-632.4311 (269)
Total kg/year			1019.8768 (272)
CO2 emissions per m2			9.0700 (273)
EI value			91.3207
EI rating			91 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				4.6300	
Infiltration rate				0.3689	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3583	0.3327	0.3413	0.3242	0.3242	0.3157	0.3071	0.2986	0.2901	0.3157	0.2986	0.3157	(22b)
Effective ac	0.5642	0.5554	0.5582	0.5526	0.5526	0.5498	0.5472	0.5446	0.5421	0.5498	0.5446	0.5498	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1881	53.3387	53.6148	53.0695	53.0695	52.8074	52.5522	52.3040	52.0628	52.8074	52.3040	52.8074	(38)
Heat transfer coeff	128.0531	127.2037	127.4798	126.9346	126.9346	126.6724	126.4172	126.1690	125.9279	126.6724	126.1690	126.6724	(39)
Average = Sum(39)m / 12 =												126.7755	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1387	1.1311	1.1336	1.1287	1.1287	1.1264	1.1241	1.1219	1.1198	1.1264	1.1219	1.1264	(40)
HLP (average)												1.1273	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(75)
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	149.1455	232.8408	365.6022	530.0878	627.7840	706.8796	663.8719	573.7552	444.4674	290.4875	181.6032	123.2124	(83)
Total gains	817.9078	896.2265	1002.5662	1126.1330	1181.6746	1223.4478	1158.9936	1078.5042	973.1127	860.2836	796.9906	773.3376	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4060	33.6291	33.5563	33.7004	33.7004	33.7702	33.8383	33.9049	33.9698	33.7702	33.9049	33.7702	
alpha	3.2271	3.2419	3.2371	3.2467	3.2467	3.2513	3.2559	3.2603	3.2647	3.2513	3.2603	3.2513	
util living area	0.9688	0.9575	0.9258	0.8526	0.7287	0.5414	0.4099	0.4363	0.6823	0.8767	0.9497	0.9726	(86)
MIT	19.3449	19.5116	19.8814	20.3467	20.7150	20.9220	20.9764	20.9719	20.8304	20.3957	19.8262	19.3320	(87)
Th 2	19.9694	19.9755	19.9735	19.9775	19.9775	19.9793	19.9812	19.9830	19.9847	19.9793	19.9830	19.9793	(88)
util rest of house	0.9629	0.9496	0.9115	0.8237	0.6751	0.4597	0.3093	0.3307	0.6059	0.8452	0.9385	0.9673	(89)
MIT 2	17.7880	18.0314	18.5580	19.2069	19.6875	19.9212	19.9701	19.9695	19.8391	19.2900	18.4928	17.7763	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2687	18.4884	18.9666	19.5588	20.0047	20.2302	20.2808	20.2789	20.1451	19.6314	18.9045	18.2566	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1187	18.3384	18.8166	19.4088	19.8547	20.0802	20.1308	20.1289	19.9951	19.4814	18.7545	18.1066	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Utilisation	0.9482	0.9326	0.8911	0.8049	0.6680	0.4682	0.3245	0.3465	0.6068	0.8265	0.9205	0.9536	(94)
Useful gains	775.5212	835.7795	893.3538	906.4266	789.3666	572.8004	376.0962	373.6780	590.4757	710.9923	733.6446	737.4885	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1692.6950	1658.5280	1506.3792	1257.7645	933.5683	605.5137	383.1399	382.1596	666.8022	1023.6892	1369.4982	1660.2457	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	682.3773	552.8870	456.0909	252.9633	107.2861	0.0000	0.0000	0.0000	0.0000	232.6465	457.8146	686.5314	(98)
Space heating												3428.5971	(98)
Space heating per m2											(98) / (4) =	30.4873	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3788.5051	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	682.3773	552.8870	456.0909	252.9633	107.2861	0.0000	0.0000	0.0000	0.0000	232.6465	457.8146	686.5314	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	754.0081	610.9249	503.9679	279.5175	118.5481	0.0000	0.0000	0.0000	0.0000	257.0680	505.8725	758.5982	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8142	89.7707	89.6335	89.3137	88.6662	87.3000	87.3000	87.3000	87.3000	89.2221	89.6445	89.8332	(217)
Fuel for water heating, kWh/month	199.8998	175.3569	182.2726	160.9538	156.6612	138.9421	130.3772	147.2980	148.3736	167.2217	179.7753	194.0345	(219)
Water heating fuel used												1981.1669	(219)
Annual totals kWh/year													
Space heating fuel - main system												3788.5051	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4936.2971	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3788.5051	10.2300	387.5641	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.1669	10.2300	202.6734	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			387.2222	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3788.5051	0.2160	818.3171	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.1669	0.2160	427.9321	(264)
Space and water heating			1246.2492	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			813.7276	(272)

13a. Primary energy - Individual heating systems including micro-CHP

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3788.5051	1.2200	4621.9763	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.1669	1.2200	2417.0236	(264)
Space and water heating			7038.9999	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4480.5389	(272)
Primary energy kWh/m2/year			39.8412	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 87	-196 kg (24.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.74 kg/m²	A 92	A 93
Total Savings	£87	1.74 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£197	£215	-£18
Mains gas	£693	£588	£105
Space heating	£518	£518	£0
Water heating	£203	£116	£87
Lighting	£169	£169	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£387	£300	£87
Total cost of uses	£387	£300	£87
Delivered energy	44 kWh/m²	35 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	40 kWh/m²	30 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4351	0.4266	0.4181	0.3754	0.3669	0.3242	0.3242	0.3157	0.3413	0.3669	0.3839	0.4010	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5498	0.5582	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1138	56.7608	56.4147	54.7893	54.4852	53.0695	53.0695	52.8074	53.6148	54.4852	55.1004	55.7436	(38)
Heat transfer coeff	130.9788	130.6258	130.2797	128.6543	128.3502	126.9346	126.9346	126.6724	127.4798	128.3502	128.9654	129.6086	(39)
Average = Sum(39)m / 12 =												128.6529	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1647	1.1615	1.1585	1.1440	1.1413	1.1287	1.1287	1.1264	1.1336	1.1413	1.1468	1.1525	(40)
HLP (average)												1.1440	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
										Solar input (sum of months) = Sum(63)m =		-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
										Total per year (kWh/year) = Sum(64)m =		886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	787.8277	880.6917	972.9486	1077.4015	1152.6173	1137.2174	1082.5651	1000.5821	914.3166	820.3730	760.6359	750.3170	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.6598	32.7481	32.8351	33.2499	33.3287	33.7004	33.7004	33.7702	33.5563	33.3287	33.1697	33.0051	
alpha	3.1773	3.1832	3.1890	3.2167	3.2219	3.2467	3.2467	3.2513	3.2371	3.2219	3.2113	3.2003	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9747	0.9626	0.9377	0.8804	0.7763	0.6243	0.4849	0.5357	0.7490	0.9079	0.9623	0.9781	(86)
MIT	19.1626	19.3737	19.7334	20.2082	20.6106	20.8661	20.9561	20.9390	20.7456	20.2312	19.6201	19.1250	(87)
Th 2	19.9484	19.9509	19.9534	19.9651	19.9672	19.9775	19.9775	19.9793	19.9735	19.9672	19.9628	19.9582	(88)
util rest of house	0.9699	0.9556	0.9256	0.8564	0.7307	0.5486	0.3840	0.4336	0.6829	0.8842	0.9540	0.9739	(89)
MIT 2	17.5113	17.8172	18.3349	19.0099	19.5494	19.8649	19.9525	19.9418	19.7357	19.0571	18.1846	17.4629	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0211	18.2977	18.7667	19.3798	19.8770	20.1740	20.2623	20.2497	20.0475	19.4196	18.6277	17.9760	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8711	18.1477	18.6167	19.2298	19.7270	20.0240	20.1123	20.0997	19.8975	19.2696	18.4777	17.8260	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9566	0.9392	0.9056	0.8359	0.7187	0.5523	0.3979	0.4464	0.6774	0.8641	0.9377	0.9618	(94)
Useful gains	753.6253	827.1458	881.0908	900.5763	828.3849	628.0562	430.7707	446.6134	619.3201	708.8536	713.2428	721.6518	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1777.5249	1730.4959	1578.5614	1328.9770	1030.2728	688.4957	445.8348	468.6456	739.0599	1112.7432	1467.3359	1766.0509	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	761.7813	607.0513	518.9181	308.4485	150.2046	0.0000	0.0000	0.0000	0.0000	300.4939	542.9470	777.0329	(98)
Space heating												3966.8776	(98)
Space heating per m2											(98) / (4) =	35.2737	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4383.2902	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	761.7813	607.0513	518.9181	308.4485	150.2046	0.0000	0.0000	0.0000	0.0000	300.4939	542.9470	777.0329	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	841.7473	670.7749	573.3902	340.8271	165.9720	0.0000	0.0000	0.0000	0.0000	332.0374	599.9414	858.5999	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9452	89.9747	90.0072	90.0641	90.1242	87.3000	87.3000	87.3000	87.3000	89.7103	89.8597	89.9574	(217)
Fuel for water heating, kWh/month	171.3441	127.8093	101.2430	52.0992	21.3916	4.2204	0.0000	31.1465	57.4037	105.8591	145.7868	170.1172	(219)
Water heating fuel used												988.4209	(219)
Annual totals kWh/year													
Space heating fuel - main system												4383.2902	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4738.7563	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4383.2902	3.4800	152.5385	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4209	3.4800	34.3970	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			223.4488	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5960	(257)
SAP value		91.6856	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4383.2902	0.2160	946.7907	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4209	0.2160	213.4989	(264)
Space and water heating			1160.2896	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			831.7860	(272)
CO2 emissions per m2			7.4000	(273)
EI value			92.9214	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3413	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3583	0.3327	0.3413	0.3242	0.3242	0.3157	0.3071	0.2986	0.2901	0.3157	0.2986	0.3157	(22b)
Effective ac	0.5642	0.5554	0.5582	0.5526	0.5526	0.5498	0.5472	0.5446	0.5421	0.5498	0.5446	0.5498	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1881	53.3387	53.6148	53.0695	53.0695	52.8074	52.5522	52.3040	52.0628	52.8074	52.3040	52.8074	(38)
Heat transfer coeff	128.0531	127.2037	127.4798	126.9346	126.9346	126.6724	126.4172	126.1690	125.9279	126.6724	126.1690	126.6724	(39)
Average = Sum(39)m / 12 =												126.7755	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1387	1.1311	1.1336	1.1287	1.1287	1.1264	1.1241	1.1219	1.1198	1.1264	1.1219	1.1264	(40)
HLP (average)												1.1273	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2724	(H8)
Utilisation factor												0.5443	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-912.8447	(H17)
Solar input	-29.7792	-42.3441	-72.7794	-98.1962	-115.3374	-123.1985	-120.6077	-107.9475	-84.5154	-58.4311	-35.2209	-24.4872	(63)
										Solar input (sum of months) = Sum(63)m =		-912.8447	(63)
Output from w/h	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
										Total per year (kWh/year) = Sum(64)m =		856.7422	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(75)
Southeast	5.8100	45.1778	0.4600	0.0000	0.7700	92.9715	(77)
Northwest	2.1700	14.6176	0.4600	0.0000	0.7700	11.2353	(81)
Northwest	5.4600	14.6176	0.4600	0.0000	0.7700	28.2695	(81)
Northwest	0.6500	21.2630	0.6300	0.7000	1.0000	5.4855	(82)

Solar gains	149.1455	232.8408	365.6022	530.0878	627.7840	706.8796	663.8719	573.7552	444.4674	290.4875	181.6032	123.2124	(83)
Total gains	817.9078	896.2265	1002.5662	1126.1330	1181.6746	1223.4478	1158.9936	1078.5042	973.1127	860.2836	796.9906	773.3376	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4060	33.6291	33.5563	33.7004	33.7004	33.7702	33.8383	33.9049	33.9698	33.7702	33.9049	33.7702	
alpha	3.2271	3.2419	3.2371	3.2467	3.2467	3.2513	3.2559	3.2603	3.2647	3.2513	3.2603	3.2513	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9688	0.9575	0.9258	0.8526	0.7287	0.5414	0.4099	0.4363	0.6823	0.8767	0.9497	0.9726 (86)
MIT	19.3449	19.5116	19.8814	20.3467	20.7150	20.9220	20.9764	20.9719	20.8304	20.3957	19.8262	19.3320 (87)
Th 2	19.9694	19.9755	19.9735	19.9775	19.9775	19.9793	19.9812	19.9830	19.9847	19.9793	19.9830	19.9793 (88)
util rest of house	0.9629	0.9496	0.9115	0.8237	0.6751	0.4597	0.3093	0.3307	0.6059	0.8452	0.9385	0.9673 (89)
MIT 2	17.7880	18.0314	18.5580	19.2069	19.6875	19.9212	19.9701	19.9695	19.8391	19.2900	18.4928	17.7763 (90)
Living area fraction									fLA = Living area / (4) =			0.3087 (91)
MIT	18.2687	18.4884	18.9666	19.5588	20.0047	20.2302	20.2808	20.2789	20.1451	19.6314	18.9045	18.2566 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1187	18.3384	18.8166	19.4088	19.8547	20.0802	20.1308	20.1289	19.9951	19.4814	18.7545	18.1066 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9326	0.8911	0.8049	0.6680	0.4682	0.3245	0.3465	0.6068	0.8265	0.9205	0.9536	(94)
Useful gains	775.5212	835.7795	893.3538	906.4266	789.3666	572.8004	376.0962	373.6780	590.4757	710.9923	733.6446	737.4885	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1692.6950	1658.5280	1506.3792	1257.7645	933.5683	605.5137	383.1399	382.1596	666.8022	1023.6892	1369.4982	1660.2457	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	682.3773	552.8870	456.0909	252.9633	107.2861	0.0000	0.0000	0.0000	0.0000	232.6465	457.8146	686.5314	(98)
Space heating												3428.5971	(98)
Space heating per m2											(98) / (4) =	30.4873	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3788.5051	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	682.3773	552.8870	456.0909	252.9633	107.2861	0.0000	0.0000	0.0000	0.0000	232.6465	457.8146	686.5314	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	754.0081	610.9249	503.9679	279.5175	118.5481	0.0000	0.0000	0.0000	0.0000	257.0680	505.8725	758.5982	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.7593	115.0751	90.5979	45.5575	23.5683	0.0000	0.0000	20.6436	45.0147	90.7677	125.9376	149.8203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9069	89.9321	89.9536	89.9966	89.9064	87.3000	87.3000	87.3000	87.3000	89.5785	89.7899	89.9096	(217)
Fuel for water heating, kWh/month	166.5715	127.9578	100.7163	50.6214	26.2142	0.0000	0.0000	23.6468	51.5633	101.3276	140.2581	166.6344	(219)
Water heating fuel used												955.5113	(219)
Annual totals kWh/year													
Space heating fuel - main system												3788.5051	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3960.6415	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3788.5051	10.2300	387.5641	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.5113	10.2300	97.7488	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	460.6022	36.7200	169.1331	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			300.6576	(255)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3788.5051	0.2160	818.3171	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.5113	0.2160	206.3904	(264)
Space and water heating			1024.7076	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			618.1360	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3788.5051	1.2200	4621.9763	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.5113	1.2200	1165.7238	(264)
Space and water heating			5787.7001	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3382.7391	(272)
Primary energy kWh/m2/year			30.0795	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	73.87	(37)
Summer heat loss coefficient	458.04	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	1.00	1.000	1.000	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.1600	98.8453	0.4600	0.0000	0.9000	88.3914
South East	5.8100	119.9223	0.4600	0.0000	0.9000	288.4540
North West	2.1700	98.8453	0.4600	0.0000	0.9000	88.8006
North West	5.4600	98.8453	0.4600	0.0000	0.9000	223.4338
North West	0.6500	156.6480	0.6300	0.7000	1.0000	40.4128
total:						729.4927

	Jun	Jul	Aug	
Solar gains	779	729	629	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1293	1222	1131	(P5)
Summer gain/loss ratio	2.82	2.67	2.47	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.86	21.61	21.31	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-321	**Issued on Date**	10/08/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	11, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	90 B	**DER**	11.16	**TER**	18.88
Environmental	91 B	**% DER<TER**	40.90		
CO_2 Emissions (t/year)	0.71	**DFEE**	51.18	**TFEE**	58.70
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.82		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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DWELLING AS BUILT

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.88 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.16 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.2 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.19 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.64 m², No overhang
Windows facing East: 0.72 m², No overhang
Windows facing South: 5.06 m², No overhang
Windows facing West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4732	0.4640	0.4547	0.4083	0.3990	0.3526	0.3526	0.3433	0.3712	0.3990	0.4176	0.4361	(22b)
Effective ac	0.6120	0.6076	0.6034	0.5834	0.5796	0.5622	0.5622	0.5589	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9654	49.6104	49.2624	47.6279	47.3221	45.8984	45.8984	45.6348	46.4468	47.3221	47.9407	48.5875	(38)
Heat transfer coeff	123.7501	123.3950	123.0470	121.4125	121.1067	119.6831	119.6831	119.4195	120.2314	121.1067	121.7254	122.3721	(39)
Average = Sum(39)m / 12 =												121.4111	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2930	1.2893	1.2856	1.2685	1.2654	1.2505	1.2505	1.2477	1.2562	1.2654	1.2718	1.2786	(40)
HLP (average)												1.2685	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	538.1515	625.0616	698.6208	768.3995	814.4857	798.5352	761.4662	712.6358	661.2072	590.0995	528.9488	507.5930	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2493	36.3536	36.4564	36.9472	37.0405	37.4811	37.4811	37.5638	37.3102	37.0405	36.8523	36.6575	
alpha	3.4166	3.4236	3.4304	3.4631	3.4694	3.4987	3.4987	3.5043	3.4873	3.4694	3.4568	3.4438	
util living area	0.9925	0.9868	0.9752	0.9465	0.8825	0.7613	0.6191	0.6681	0.8559	0.9604	0.9876	0.9939	(86)
MIT	19.0446	19.2507	19.5903	20.0480	20.4766	20.7962	20.9289	20.9055	20.6607	20.1102	19.5002	19.0138	(87)
Th 2	19.8463	19.8493	19.8521	19.8656	19.8681	19.8798	19.8798	19.8820	19.8753	19.8681	19.8630	19.8577	(88)
util rest of house	0.9907	0.9836	0.9687	0.9310	0.8450	0.6795	0.4896	0.5431	0.7958	0.9460	0.9840	0.9924	(89)
MIT 2	17.2474	17.5489	18.0434	18.7078	19.3019	19.7112	19.8426	19.8277	19.5582	18.8068	17.9226	17.2093	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.5208	17.8078	18.2787	18.9117	19.4806	19.8763	20.0078	19.9916	19.7259	19.0050	18.1626	17.4838	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3708	17.6578	18.1287	18.7617	19.3306	19.7263	19.8578	19.8416	19.5759	18.8550	18.0126	17.3338	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9843	0.9740	0.9543	0.9105	0.8225	0.6664	0.4868	0.5380	0.7755	0.9273	0.9746	0.9870	(94)
Useful gains	529.7250	608.8362	666.7262	699.6576	669.9269	532.1309	370.6682	383.4022	512.7537	547.2122	515.5295	500.9945	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1617.5116	1574.2465	1430.8788	1197.3303	924.1128	613.5317	389.9091	410.9997	658.3769	999.7419	1328.3365	1607.2111	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	809.3132	648.7557	568.5295	358.3244	189.1143	0.0000	0.0000	0.0000	0.0000	336.6821	585.2211	823.0252	(98)
Space heating												4318.9656	(98)
Space heating per m2											(98) / (4) =	45.1255	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4772.3377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	809.3132	648.7557	568.5295	358.3244	189.1143	0.0000	0.0000	0.0000	0.0000	336.6821	585.2211	823.0252	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	894.2688	716.8572	628.2094	395.9385	208.9661	0.0000	0.0000	0.0000	0.0000	372.0244	646.6531	909.4201	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9157	89.8716	89.7817	89.5790	89.1390	87.3000	87.3000	87.3000	87.3000	89.5124	89.8052	89.9375	(217)
Fuel for water heating, kWh/month													
	193.9424	170.1445	176.7909	155.9398	151.4560	135.0886	126.8064	143.1997	144.2255	161.9756	174.3355	188.2600	(219)
Water heating fuel used												1922.1650	(219)
Annual totals kWh/year													
Space heating fuel - main system												4772.3377	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												5967.0249	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4772.3377	0.2160	1030.8249	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.1650	0.2160	415.1876	(264)
Space and water heating			1446.0126	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1068.4516	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.1600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.1600	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		28.5084	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.5084	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772	(83)
Total gains	533.7078	608.3817	669.7815	726.0139	761.6960	744.0053	709.9268	669.3371	627.3704	570.0222	521.1234	505.6162	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9985	0.9970	0.9929	0.9792	0.9357	0.8206	0.6610	0.7131	0.9090	0.9854	0.9971	0.9989	(86)
MIT	19.6160	19.7601	20.0026	20.3359	20.6537	20.8869	20.9706	20.9575	20.7889	20.3840	19.9448	19.5964	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9980	0.9959	0.9902	0.9703	0.9050	0.7351	0.5210	0.5777	0.8531	0.9776	0.9958	0.9985	(89)
MIT 2	18.0535	18.2661	18.6215	19.1125	19.5557	19.8481	19.9195	19.9142	19.7421	19.1876	18.5462	18.0328	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9938	0.9862	0.9633	0.8979	0.7421	0.5419	0.5972	0.8514	0.9717	0.9938	0.9976	(94)
Useful gains	532.0236	604.5960	660.5534	699.3443	683.8904	552.1036	384.7414	399.7568	534.1382	553.8897	517.8729	504.3851	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1645.0618	1593.4639	1441.2580	1198.3354	922.0806	613.6516	394.9410	415.9385	661.6907	1007.9209	1347.2259	1635.0137	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating												4386.0721	(98)
Space heating per m2											(98) / (4) =	45.8267	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4696.0086	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	886.6171	711.4767	621.8889	384.6613	189.7361	0.0000	0.0000	0.0000	0.0000	361.6694	639.3299	900.6292	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1470	87.9782	87.6238	86.8421	85.1852	80.3000	80.3000	80.3000	80.3000	86.5884	87.7134	88.2160	(217)
Fuel for water heating, kWh/month													
	239.6027	211.6176	223.2056	199.8567	197.2602	184.3053	176.5785	196.8436	199.0176	210.0470	219.1474	233.6834	(219)
Water heating fuel used												2491.1657	(219)
Annual totals kWh/year													
Space heating fuel - main system												4696.0086	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7678.2537	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4696.0086	0.2160	1014.3379	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2491.1657	0.2160	538.0918	(264)
Space and water heating			1552.4296	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1807.2998	(272)
Emissions per m2 for space and water heating			16.2201	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2201 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.8800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1213	(8)
Pressure test				Yes	
Measured/design AP50				4.1900	
Infiltration rate				0.3308	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3308	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4217	0.4134	0.4052	0.3638	0.3556	0.3142	0.3142	0.3059	0.3308	0.3556	0.3721	0.3886	(22b)
Effective ac	0.5889	0.5855	0.5821	0.5662	0.5632	0.5494	0.5494	0.5468	0.5547	0.5632	0.5692	0.5755	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004	(36)
Total fabric heat loss	(33) + (36) =	73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.0826	47.8007	47.5244	46.2265	45.9836	44.8532	44.8532	44.6438	45.2886	45.9836	46.4749	46.9885	(38)
Heat transfer coeff	121.8673	121.5854	121.3090	120.0111	119.7683	118.6378	118.6378	118.4285	119.0733	119.7683	120.2595	120.7731	(39)
Average = Sum(39)m / 12 =												120.0100	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2733	1.2704	1.2675	1.2539	1.2514	1.2396	1.2396	1.2374	1.2441	1.2514	1.2565	1.2619	(40)
HLP (average)												1.2539	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	504.5541	592.2872	667.5555	739.6617	787.2599	773.4361	738.1715	687.0256	634.7718	561.2557	497.3894	474.8151	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.8093	36.8947	36.9787	37.3787	37.4544	37.8113	37.8113	37.8782	37.6731	37.4544	37.3014	37.1428	
alpha	3.4540	3.4596	3.4652	3.4919	3.4970	3.5208	3.5208	3.5252	3.5115	3.4970	3.4868	3.4762	
util living area													
	0.9939	0.9888	0.9781	0.9511	0.8897	0.7716	0.6299	0.6815	0.8664	0.9652	0.9897	0.9951	(86)
MIT	19.0339	19.2402	19.5802	20.0359	20.4673	20.7900	20.9263	20.9010	20.6493	20.0930	19.4821	18.9993	(87)
Th 2	19.8618	19.8641	19.8664	19.8771	19.8791	19.8885	19.8885	19.8902	19.8849	19.8791	19.8751	19.8708	(88)
util rest of house													
	0.9924	0.9860	0.9723	0.9368	0.8539	0.6913	0.5006	0.5572	0.8090	0.9524	0.9867	0.9939	(89)
MIT 2	18.0726	18.2793	18.6182	19.0729	19.4831	19.7687	19.8618	19.8508	19.6586	19.1358	18.5294	18.0446	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.2188	18.4255	18.7645	19.2194	19.6328	19.9240	20.0237	20.0105	19.8093	19.2814	18.6743	18.1899	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2188	18.4255	18.7645	19.2194	19.6328	19.9240	20.0237	20.0105	19.8093	19.2814	18.6743	18.1899	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9811	0.9647	0.9261	0.8444	0.6943	0.5179	0.5724	0.8042	0.9432	0.9821	0.9913	(94)
Useful gains	499.1496	581.0970	644.0006	685.0133	664.7371	536.9904	382.2813	393.2250	510.5037	529.3589	488.4627	470.6614	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1696.2501	1644.5030	1487.7953	1238.4467	950.0965	631.6336	406.1862	427.5887	679.8267	1039.7613	1391.9208	1689.5993	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	890.6428	714.6088	627.7833	398.4720	212.3074	0.0000	0.0000	0.0000	0.0000	379.7394	650.4899	906.8898	(98)
Space heating												4780.9335	(98)
Space heating per m2											(98) / (4) =	49.9523	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1115.1956	877.9199	900.0565	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7376	0.8136	0.7816	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	822.5265	714.3073	703.4668	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1881	963.8191	906.0197	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	132.9563	185.6368	150.6993	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												469.2925	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	33.2391	46.4092	37.6748	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												117.3231	(107)
Space cooling per m2												1.2258	(108)
Energy for space heating												49.9523	(99)
Energy for space cooling												1.2258	(108)
Total												51.1781	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772	(83)
Total gains	487.7388	563.2316	626.3320	685.5155	723.3715	708.4671	676.1850	632.6207	589.1634	528.7832	477.1824	460.4627	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9990	0.9978	0.9946	0.9834	0.9460	0.8409	0.6861	0.7415	0.9253	0.9893	0.9980	0.9993	(86)
MIT	19.5718	19.7170	19.9618	20.3002	20.6261	20.8725	20.9654	20.9494	20.7645	20.3465	19.9027	19.5528	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9987	0.9971	0.9925	0.9761	0.9189	0.7592	0.5445	0.6063	0.8759	0.9833	0.9972	0.9990	(89)
MIT 2	18.5943	18.7416	18.9879	19.3333	19.6471	19.8657	19.9215	19.9173	19.7820	19.3835	18.9383	18.5845	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9960	0.9905	0.9722	0.9150	0.7671	0.5661	0.6264	0.8762	0.9802	0.9962	0.9986	(94)
Useful gains	486.8312	560.9916	620.3711	666.4239	661.8783	543.4498	382.7621	396.2456	516.2265	518.3250	475.3671	459.8187	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1698.1893	1639.9559	1476.8370	1219.2851	930.5096	615.0903	395.0508	416.0966	665.1267	1026.3540	1384.9004	1688.5901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	901.2504	725.0640	637.2106	398.0601	199.8617	0.0000	0.0000	0.0000	0.0000	377.9736	654.8639	914.2059	(98)
Space heating												4808.4902	(98)
Space heating per m2											(98) / (4) =	50.2402	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7696	0.8543	0.8219	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	821.1529	717.5810	707.3429	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	931.2502	891.3674	842.4295	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	79.2701	129.2970	100.5044	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												309.0716 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	19.8175	32.3243	25.1261	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												77.2679 (107)
Space cooling per m2												0.8073 (108)
Energy for space heating												50.2402 (99)
Energy for space cooling												0.8073 (108)
Total												51.0475 (109)
Target Fabric Energy Efficiency (TFEE)												58.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3897	0.3619	0.3712	0.3526	0.3526	0.3433	0.3341	0.3248	0.3155	0.3433	0.3248	0.3433	(22b)
Effective ac	0.5759	0.5655	0.5689	0.5622	0.5622	0.5589	0.5558	0.5527	0.5498	0.5589	0.5527	0.5589	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0233	46.1691	46.4468	45.8984	45.8984	45.6348	45.3782	45.1286	44.8861	45.6348	45.1286	45.6348	(38)
Heat transfer coeff	120.8079	119.9538	120.2314	119.6831	119.6831	119.4195	119.1629	118.9133	118.6707	119.4195	118.9133	119.4195	(39)
Average = Sum(39)m / 12 =												119.5232	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2622	1.2533	1.2562	1.2505	1.2505	1.2477	1.2450	1.2424	1.2399	1.2477	1.2424	1.2477	(40)
HLP (average)												1.2488	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918	(83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1321	37.3965	37.3102	37.4811	37.4811	37.5638	37.6447	37.7237	37.8008	37.5638	37.7237	37.5638	
alpha	3.4755	3.4931	3.4873	3.4987	3.4987	3.5043	3.5096	3.5149	3.5201	3.5043	3.5149	3.5043	
util living area													
	0.9756	0.9666	0.9427	0.8882	0.7860	0.6062	0.4619	0.4803	0.7185	0.8943	0.9587	0.9787	(86)
MIT	19.4644	19.6147	19.9369	20.3468	20.6974	20.9142	20.9751	20.9720	20.8378	20.4402	19.9173	19.4542	(87)
Th 2	19.8705	19.8776	19.8753	19.8798	19.8798	19.8820	19.8841	19.8862	19.8882	19.8820	19.8862	19.8820	(88)
util rest of house													
	0.9699	0.9589	0.9289	0.8599	0.7290	0.5095	0.3387	0.3535	0.6324	0.8608	0.9475	0.9737	(89)
MIT 2	17.8701	18.0906	18.5495	19.1239	19.5827	19.8235	19.8743	19.8750	19.7592	19.2639	18.5349	17.8632	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1127	18.3224	18.7606	19.3099	19.7523	19.9894	20.0418	20.0419	19.9233	19.4429	18.7452	18.1052	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9627	18.1724	18.6106	19.1599	19.6023	19.8394	19.8918	19.8919	19.7733	19.2929	18.5952	17.9552	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9426	0.9084	0.8375	0.7127	0.5055	0.3395	0.3542	0.6222	0.8384	0.9293	0.9610	(94)
Useful gains	735.2830	787.7639	826.1109	819.8627	709.5494	512.1309	327.4334	326.0459	538.7557	667.8457	697.2797	699.2940	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1578.0732	1544.0964	1395.9571	1156.1288	850.0195	542.0914	332.6775	331.9965	602.0512	942.5609	1271.8023	1547.1080	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.0359	508.2554	423.9656	242.1115	104.5097	0.0000	0.0000	0.0000	0.0000	204.3881	413.6563	630.7737	(98)
Space heating												3154.6963	(98)
RHI space heating demand												3155	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4732	0.4640	0.4547	0.4083	0.3990	0.3526	0.3526	0.3433	0.3712	0.3990	0.4176	0.4361	(22b)
Effective ac	0.6120	0.6076	0.6034	0.5834	0.5796	0.5622	0.5622	0.5589	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9654	49.6104	49.2624	47.6279	47.3221	45.8984	45.8984	45.6348	46.4468	47.3221	47.9407	48.5875	(38)
Heat transfer coeff	123.7501	123.3950	123.0470	121.4125	121.1067	119.6831	119.6831	119.4195	120.2314	121.1067	121.7254	122.3721	(39)
Average = Sum(39)m / 12 =												121.4111	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2930	1.2893	1.2856	1.2685	1.2654	1.2505	1.2505	1.2477	1.2562	1.2654	1.2718	1.2786	(40)
HLP (average)												1.2685	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m
24.0365 21.0225 21.6933 18.9128 18.1473 15.6597 14.5110 16.6516 16.8505 19.6376 21.4360 23.2781 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 14.1411 12.7616 14.1037 13.6041 14.0247 13.5343 13.9618 14.0026 13.5723 14.0708 13.6558 14.1290 (61)
Total heat required for water heating calculated for each month
174.3847 152.9117 158.7259 139.6893 135.0064 117.9324 110.7020 125.0133 125.9089 144.9882 156.5624 169.3163 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
174.3847 152.9117 158.7259 139.6893 135.0064 117.9324 110.7020 125.0133 125.9089 144.9882 156.5624 169.3163 (64)
Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)
Heat gains from water heating, kWh/month
56.8163 49.7903 51.6128 45.3244 43.7326 38.0959 35.6566 40.4117 40.7450 47.0477 50.9304 55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2493	36.3536	36.4564	36.9472	37.0405	37.4811	37.4811	37.5638	37.3102	37.0405	36.8523	36.6575	
alpha	3.4166	3.4236	3.4304	3.4631	3.4694	3.4987	3.4987	3.5043	3.4873	3.4694	3.4568	3.4438	
util living area	0.9805	0.9706	0.9518	0.9098	0.8274	0.6867	0.5390	0.5810	0.7806	0.9222	0.9698	0.9833	(86)
MIT	19.2897	19.4852	19.8014	20.2192	20.5934	20.8556	20.9540	20.9394	20.7584	20.2875	19.7214	19.2562	(87)
Th 2	19.8463	19.8493	19.8521	19.8656	19.8681	19.8798	19.8798	19.8820	19.8753	19.8681	19.8630	19.8577	(88)
util rest of house	0.9761	0.9638	0.9402	0.8867	0.7804	0.6004	0.4178	0.4610	0.7074	0.8975	0.9617	0.9795	(89)
MIT 2	17.6019	17.8859	18.3417	18.9398	19.4439	19.7663	19.8571	19.8495	19.6630	19.0469	18.2393	17.5607	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8587	18.1292	18.5638	19.1345	19.6188	19.9320	20.0240	20.0153	19.8296	19.2357	18.4648	17.8186	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7087	17.9792	18.4138	18.9845	19.4688	19.7820	19.8740	19.8653	19.6796	19.0857	18.3148	17.6686	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9482	0.9205	0.8639	0.7607	0.5920	0.4171	0.4590	0.6924	0.8750	0.9457	0.9685	(94)
Useful gains	713.7756	782.1154	818.6040	817.2780	744.4785	563.7663	379.9007	396.8971	569.4015	668.6977	677.7100	683.3544	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1659.3258	1613.9080	1465.9545	1224.3795	940.8529	620.2028	391.8417	413.8212	670.8426	1027.6710	1365.1261	1648.1847	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	703.4894	558.9646	481.6288	293.1130	146.1026	0.0000	0.0000	0.0000	0.0000	267.0761	494.9396	717.8337	(98)
Space heating												3663.1478	(98)
Space heating per m2											(98) / (4) =	38.2734	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4047.6772	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	703.4894	558.9646	481.6288	293.1130	146.1026	0.0000	0.0000	0.0000	0.0000	267.0761	494.9396	717.8337	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	777.3363	617.6405	532.1865	323.8818	161.4393	0.0000	0.0000	0.0000	0.0000	295.1117	546.8946	793.1865	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8458	89.7930	89.6851	89.4418	88.9344	87.3000	87.3000	87.3000	87.3000	89.3476	89.7098	89.8713	(217)
Fuel for water heating, kWh/month													
	194.0933	170.2935	176.9813	156.1789	151.8045	135.0886	126.8064	143.1997	144.2255	162.2742	174.5210	188.3987	(219)
Water heating fuel used												1923.8657	(219)
Annual totals kWh/year													
Space heating fuel - main system												4047.6772	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5244.0652	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4047.6772	3.4800	140.8592	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.8657	3.4800	66.9505	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			231.8554	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6921	(257)
SAP value		90.3458	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4047.6772	0.2160	874.2983	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.8657	0.2160	415.5550	(264)
Space and water heating			1289.8533	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			912.2923	(272)
CO2 emissions per m2			9.5300	(273)
EI value			91.3121	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3897	0.3619	0.3712	0.3526	0.3526	0.3433	0.3341	0.3248	0.3155	0.3433	0.3248	0.3433	(22b)
Effective ac	0.5759	0.5655	0.5689	0.5622	0.5622	0.5589	0.5558	0.5527	0.5498	0.5589	0.5527	0.5589	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0233	46.1691	46.4468	45.8984	45.8984	45.6348	45.3782	45.1286	44.8861	45.6348	45.1286	45.6348	(38)
Heat transfer coeff	120.8079	119.9538	120.2314	119.6831	119.6831	119.4195	119.1629	118.9133	118.6707	119.4195	118.9133	119.4195	(39)
Average = Sum(39)m / 12 =												119.5232	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2622	1.2533	1.2562	1.2505	1.2505	1.2477	1.2450	1.2424	1.2399	1.2477	1.2424	1.2477	(40)
HLP (average)												1.2488	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918	(83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1321	37.3965	37.3102	37.4811	37.4811	37.5638	37.6447	37.7237	37.8008	37.5638	37.7237	37.5638	
alpha	3.4755	3.4931	3.4873	3.4987	3.4987	3.5043	3.5096	3.5149	3.5201	3.5043	3.5149	3.5043	
util living area													
	0.9756	0.9666	0.9427	0.8882	0.7860	0.6062	0.4619	0.4803	0.7185	0.8943	0.9587	0.9787	(86)
MIT	19.4644	19.6147	19.9369	20.3468	20.6974	20.9142	20.9751	20.9720	20.8378	20.4402	19.9173	19.4542	(87)
Th 2	19.8705	19.8776	19.8753	19.8798	19.8798	19.8820	19.8841	19.8862	19.8882	19.8820	19.8862	19.8820	(88)
util rest of house													
	0.9699	0.9589	0.9289	0.8599	0.7290	0.5095	0.3387	0.3535	0.6324	0.8608	0.9475	0.9737	(89)
MIT 2	17.8701	18.0906	18.5495	19.1239	19.5827	19.8235	19.8743	19.8750	19.7592	19.2639	18.5349	17.8632	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1127	18.3224	18.7606	19.3099	19.7523	19.9894	20.0418	20.0419	19.9233	19.4429	18.7452	18.1052	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9627	18.1724	18.6106	19.1599	19.6023	19.8394	19.8918	19.8919	19.7733	19.2929	18.5952	17.9552	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9426	0.9084	0.8375	0.7127	0.5055	0.3395	0.3542	0.6222	0.8384	0.9293	0.9610	(94)
Useful gains	735.2830	787.7639	826.1109	819.8627	709.5494	512.1309	327.4334	326.0459	538.7557	667.8457	697.2797	699.2940	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1578.0732	1544.0964	1395.9571	1156.1288	850.0195	542.0914	332.6775	331.9965	602.0512	942.5609	1271.8023	1547.1080	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.0359	508.2554	423.9656	242.1115	104.5097	0.0000	0.0000	0.0000	0.0000	204.3881	413.6563	630.7737	(98)
Space heating												3154.6963	(98)
Space heating per m2											(98) / (4) =	32.9610	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3485.8523	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	627.0359	508.2554	423.9656	242.1115	104.5097	0.0000	0.0000	0.0000	0.0000	204.3881	413.6563	630.7737	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	692.8574	561.6082	468.4703	267.5266	115.4804	0.0000	0.0000	0.0000	0.0000	225.8433	457.0788	696.9875	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7839	89.7392	89.6053	89.3024	88.6680	87.3000	87.3000	87.3000	87.3000	89.1440	89.5983	89.8034	(217)
Fuel for water heating, kWh/month													
	194.2272	170.3956	177.1390	156.4229	152.2606	135.0886	126.8064	143.1997	144.2255	162.6450	174.7382	188.5411	(219)
Water heating fuel used												1925.6897	(219)
Annual totals kWh/year													
Space heating fuel - main system												3485.8523	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4533.6442	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3485.8523	10.2300	356.6027	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1925.6897	10.2300	196.9981	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			334.2367	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3485.8523	0.2160	752.9441	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.6897	0.2160	415.9490	(264)
Space and water heating			1168.8931	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			713.2641	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3485.8523	1.2200	4252.7398	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.6897	1.2200	2349.3414	(264)
Space and water heating			6602.0812	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3906.9351	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 40.8206 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-192 kg (26.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.00 kg/m²	B 91	A 93
Total Savings	£85	2.00 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£180	£199	-£18
Mains gas	£657	£554	£103
Space heating	£487	£487	£0
Water heating	£197	£112	£85
Lighting	£153	£153	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£334	£250	£85
Total cost of uses	£334	£249	£85
Delivered energy	47 kWh/m²	37 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	30 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4732	0.4640	0.4547	0.4083	0.3990	0.3526	0.3526	0.3433	0.3712	0.3990	0.4176	0.4361	(22b)
Effective ac	0.6120	0.6076	0.6034	0.5834	0.5796	0.5622	0.5622	0.5589	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9654	49.6104	49.2624	47.6279	47.3221	45.8984	45.8984	45.6348	46.4468	47.3221	47.9407	48.5875	(38)
Heat transfer coeff	123.7501	123.3950	123.0470	121.4125	121.1067	119.6831	119.6831	119.4195	120.2314	121.1067	121.7254	122.3721	(39)
Average = Sum(39)m / 12 =												121.4111	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2930	1.2893	1.2856	1.2685	1.2654	1.2505	1.2505	1.2477	1.2562	1.2654	1.2718	1.2786	(40)
HLP (average)												1.2685	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1734	(H8)
Utilisation factor												0.5735	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-865.2421	(H17)
Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963	(63)
											Solar input (sum of months) = Sum(63)m =	-865.2421	(63)
Output from w/h													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
											Total per year (kWh/year) = Sum(64)m =	849.7380	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2493	36.3536	36.4564	36.9472	37.0405	37.4811	37.4811	37.5638	37.3102	37.0405	36.8523	36.6575	
alpha	3.4166	3.4236	3.4304	3.4631	3.4694	3.4987	3.4987	3.5043	3.4873	3.4694	3.4568	3.4438	
util living area													
	0.9805	0.9706	0.9518	0.9098	0.8274	0.6867	0.5390	0.5810	0.7806	0.9222	0.9698	0.9833	(86)
MIT	19.2897	19.4852	19.8014	20.2192	20.5934	20.8556	20.9540	20.9394	20.7584	20.2875	19.7214	19.2562	(87)
Th 2	19.8463	19.8493	19.8521	19.8656	19.8681	19.8798	19.8798	19.8820	19.8753	19.8681	19.8630	19.8577	(88)
util rest of house													
	0.9761	0.9638	0.9402	0.8867	0.7804	0.6004	0.4178	0.4610	0.7074	0.8975	0.9617	0.9795	(89)
MIT 2	17.6019	17.8859	18.3417	18.9398	19.4439	19.7663	19.8571	19.8495	19.6630	19.0469	18.2393	17.5607	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8587	18.1292	18.5638	19.1345	19.6188	19.9320	20.0240	20.0153	19.8296	19.2357	18.4648	17.8186	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7087	17.9792	18.4138	18.9845	19.4688	19.7820	19.8740	19.8653	19.6796	19.0857	18.3148	17.6686	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9482	0.9205	0.8639	0.7607	0.5920	0.4171	0.4590	0.6924	0.8750	0.9457	0.9685	(94)
Useful gains	713.7756	782.1154	818.6040	817.2780	744.4785	563.7663	379.9007	396.8971	569.4015	668.6977	677.7100	683.3544	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1659.3258	1613.9080	1465.9545	1224.3795	940.8529	620.2028	391.8417	413.8212	670.8426	1027.6710	1365.1261	1648.1847	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	703.4894	558.9646	481.6288	293.1130	146.1026	0.0000	0.0000	0.0000	0.0000	267.0761	494.9396	717.8337	(98)
Space heating												3663.1478	(98)
Space heating per m2											(98) / (4) =	38.2734	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4047.6772	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	703.4894	558.9646	481.6288	293.1130	146.1026	0.0000	0.0000	0.0000	0.0000	267.0761	494.9396	717.8337	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	777.3363	617.6405	532.1865	323.8818	161.4393	0.0000	0.0000	0.0000	0.0000	295.1117	546.8946	793.1865	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9230	89.9535	89.9932	90.0680	90.1566	87.3000	87.3000	87.3000	87.3000	89.6616	89.8285	89.9355	(217)
Fuel for water heating, kWh/month	166.0248	123.4451	97.1396	48.9898	18.7936	2.1281	0.0000	28.5666	54.4449	102.0112	141.1598	164.9183	(219)
Water heating fuel used												947.6218	(219)
Annual totals kWh/year													
Space heating fuel - main system												4047.6772	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4317.8212	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4047.6772	3.4800	140.8592	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.6218	3.4800	32.9772	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			204.4771	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6103	(257)
SAP value	91.4858	
SAP rating (Section 12)	91	(258)
SAP band	B	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4047.6772	0.2160	874.2983	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.6218	0.2160	204.6863	(264)
Space and water heating			1078.9846	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			727.3736	(272)
CO2 emissions per m2			7.6000	(273)
EI value			93.0731	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.1900	
Infiltration rate		0.3712	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3712	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3897	0.3619	0.3712	0.3526	0.3526	0.3433	0.3341	0.3248	0.3155	0.3433	0.3248	0.3433	(22b)
Effective ac	0.5759	0.5655	0.5689	0.5622	0.5622	0.5589	0.5558	0.5527	0.5498	0.5589	0.5527	0.5589	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0233	46.1691	46.4468	45.8984	45.8984	45.6348	45.3782	45.1286	44.8861	45.6348	45.1286	45.6348	(38)
Heat transfer coeff	120.8079	119.9538	120.2314	119.6831	119.6831	119.4195	119.1629	118.9133	118.6707	119.4195	118.9133	119.4195	(39)
Average = Sum(39)m / 12 =												119.5232	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2622	1.2533	1.2562	1.2505	1.2505	1.2477	1.2450	1.2424	1.2399	1.2477	1.2424	1.2477	(40)
HLP (average)												1.2488	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3132 (H8)
Utilisation factor	0.5330 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	98.2325 (H14)
Volume ratio Veff/V	0.7635 (H15)
Solar storage volume factor	0.9460 (H16)
Solar input	-899.9506 (H17)

Solar input

	-29.3586	-41.7460	-71.7514	-96.8092	-113.7082	-121.4583	-118.9041	-106.4227	-83.3217	-57.6057	-34.7234	-24.1413 (63)

Solar input (sum of months) = Sum(63)m = -899.9506 (63)

Output from w/h

	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750 (64)

Total per year (kWh/year) = Sum(64)m = 822.9189 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918 (83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1321	37.3965	37.3102	37.4811	37.4811	37.5638	37.6447	37.7237	37.8008	37.5638	37.7237	37.5638	
alpha	3.4755	3.4931	3.4873	3.4987	3.4987	3.5043	3.5096	3.5149	3.5201	3.5043	3.5149	3.5043	
util living area													
	0.9756	0.9666	0.9427	0.8882	0.7860	0.6062	0.4619	0.4803	0.7185	0.8943	0.9587	0.9787	(86)
MIT	19.4644	19.6147	19.9369	20.3468	20.6974	20.9142	20.9751	20.9720	20.8378	20.4402	19.9173	19.4542	(87)
Th 2	19.8705	19.8776	19.8753	19.8798	19.8798	19.8820	19.8841	19.8862	19.8882	19.8820	19.8862	19.8820	(88)
util rest of house													
	0.9699	0.9589	0.9289	0.8599	0.7290	0.5095	0.3387	0.3535	0.6324	0.8608	0.9475	0.9737	(89)
MIT 2	17.8701	18.0906	18.5495	19.1239	19.5827	19.8235	19.8743	19.8750	19.7592	19.2639	18.5349	17.8632	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1127	18.3224	18.7606	19.3099	19.7523	19.9894	20.0418	20.0419	19.9233	19.4429	18.7452	18.1052	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9627	18.1724	18.6106	19.1599	19.6023	19.8394	19.8918	19.8919	19.7733	19.2929	18.5952	17.9552	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9426	0.9084	0.8375	0.7127	0.5055	0.3395	0.3542	0.6222	0.8384	0.9293	0.9610	(94)
Useful gains	735.2830	787.7639	826.1109	819.8627	709.5494	512.1309	327.4334	326.0459	538.7557	667.8457	697.2797	699.2940	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1578.0732	1544.0964	1395.9571	1156.1288	850.0195	542.0914	332.6775	331.9965	602.0512	942.5609	1271.8023	1547.1080	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	627.0359	508.2554	423.9656	242.1115	104.5097	0.0000	0.0000	0.0000	0.0000	204.3881	413.6563	630.7737	(98)
Space heating												3154.6963	(98)
Space heating per m2											(98) / (4) =	32.9610	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3485.8523	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	627.0359	508.2554	423.9656	242.1115	104.5097	0.0000	0.0000	0.0000	0.0000	204.3881	413.6563	630.7737	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	692.8574	561.6082	468.4703	267.5266	115.4804	0.0000	0.0000	0.0000	0.0000	225.8433	457.0788	696.9875	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8811	89.9085	89.9388	90.0036	89.9419	87.3000	87.3000	87.3000	87.3000	89.5173	89.7515	89.8836	(217)
Fuel for water heating, kWh/month	161.3533	123.6430	96.7042	47.6427	23.6800	0.0000	0.0000	21.2950	48.7826	97.6152	135.7515	161.5145	(219)
Water heating fuel used												917.9819	(219)
Annual totals kWh/year													
Space heating fuel - main system												3485.8523	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =											-1368.9771	-1368.9771	(233)
Total delivered energy for all uses												3575.9364	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3485.8523	10.2300	356.6027	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	917.9819	10.2300	93.9095	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			249.5082	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3485.8523	0.2160	752.9441	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9819	0.2160	198.2841	(264)
Space and water heating			951.2282	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			521.5492	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3485.8523	1.2200	4252.7398	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9819	1.2200	1119.9379	(264)
Space and water heating			5372.6777	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2831.0316	(272)
Primary energy kWh/m2/year			29.5793	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.3100	81.1852	0.4600	0.0000	0.9000	144.8620
East	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	5.0600	112.2060	0.4600	0.0000	0.9000	235.0536
West	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
North	3.3300	81.1852	0.4600	0.0000	0.9000	111.9235
total:						561.8921

	Jun	Jul	Aug	
Solar gains	596	562	502	(P4)
Internal gains	476	456	465	
Total summer gains	1072	1018	967	(P5)
Summer gain/loss ratio	2.68	2.54	2.42	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.50	21.26	21.04	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-322	**Issued on Date**	15/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	13, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	91 B	**DER**	11.00	**TER**	18.88
Environmental	91 B	**% DER<TER**	41.75		
CO_2 Emissions (t/year)	0.69	**DFEE**	51.87	**TFEE**	58.70
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.64		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.88 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.00 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.92 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.64 m², No overhang
Windows facing East: 0.72 m², No overhang
Windows facing South: 5.06 m², No overhang
Windows facing West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4077	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5198	0.5096	0.4994	0.4484	0.4383	0.3873	0.3873	0.3771	0.4077	0.4383	0.4586	0.4790	(22b)
Effective ac	0.6351	0.6298	0.6247	0.6006	0.5960	0.5750	0.5750	0.5711	0.5831	0.5960	0.6052	0.6147	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8520	51.4237	51.0039	49.0321	48.6632	46.9458	46.9458	46.6278	47.6073	48.6632	49.4095	50.1897	(38)
Heat transfer coeff	125.4647	125.0364	124.6166	122.6448	122.2759	120.5585	120.5585	120.2405	121.2201	122.2759	123.0222	123.8025	(39)
Average = Sum(39)m / 12 =												122.6431	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3109	1.3064	1.3020	1.2814	1.2776	1.2596	1.2596	1.2563	1.2665	1.2776	1.2854	1.2935	(40)
HLP (average)												1.2814	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961	(42)
Average daily hot water use (litres/day)	98.2325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	538.1515	625.0616	698.6208	768.3995	814.4857	798.5352	761.4662	712.6358	661.2072	590.0995	528.9488	507.5930	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7463	35.8687	35.9896	36.5682	36.6785	37.2010	37.2010	37.2994	36.9980	36.6785	36.4560	36.2262	
alpha	3.3831	3.3912	3.3993	3.4379	3.4452	3.4801	3.4801	3.4866	3.4665	3.4452	3.4304	3.4151	
util living area													
	0.9925	0.9869	0.9754	0.9470	0.8838	0.7633	0.6217	0.6704	0.8573	0.9607	0.9876	0.9939	(86)
MIT	19.0162	19.2239	19.5668	20.0321	20.4655	20.7915	20.9266	20.9030	20.6539	20.0973	19.4817	18.9899	(87)
Th 2	19.8323	19.8358	19.8392	19.8554	19.8584	19.8726	19.8726	19.8752	19.8671	19.8584	19.8523	19.8459	(88)
util rest of house													
	0.9907	0.9836	0.9689	0.9316	0.8463	0.6814	0.4914	0.5449	0.7972	0.9463	0.9840	0.9924	(89)
MIT 2	17.1976	17.5019	18.0014	18.6788	19.2802	19.7001	19.8342	19.8195	19.5437	18.7823	17.8893	17.1674	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.4742	17.7638	18.2395	18.8847	19.4605	19.8661	20.0004	19.9843	19.7126	18.9823	18.1316	17.4446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3242	17.6138	18.0895	18.7347	19.3105	19.7161	19.8504	19.8343	19.5626	18.8323	17.9816	17.2946	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9842	0.9740	0.9544	0.9109	0.8236	0.6680	0.4885	0.5397	0.7767	0.9275	0.9746	0.9869	(94)
Useful gains	529.6623	608.7890	666.7679	699.9618	670.8413	533.4337	372.0105	384.5822	513.5464	547.3380	515.4938	500.9442	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1634.0828	1589.6912	1444.2458	1206.1720	930.5829	616.7920	391.8671	412.9427	662.1749	1006.6170	1338.6759	1621.1444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	821.6889	659.1663	578.4436	364.4714	193.2477	0.0000	0.0000	0.0000	0.0000	341.7036	592.6912	833.4289	(98)
Space heating												4384.8415	(98)
Space heating per m2											(98) / (4) =	45.8138	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4845.1287	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	821.6889	659.1663	578.4436	364.4714	193.2477	0.0000	0.0000	0.0000	0.0000	341.7036	592.6912	833.4289	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	907.9435	728.3605	639.1642	402.7308	213.5334	0.0000	0.0000	0.0000	0.0000	377.5730	654.9074	920.9160	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9229	89.8796	89.7913	89.5901	89.1559	87.3000	87.3000	87.3000	87.3000	89.5224	89.8121	89.9433	(217)
Fuel for water heating, kWh/month													
	193.9268	170.1294	176.7720	155.9205	151.4274	135.0886	126.8064	143.1997	144.2255	161.9574	174.3222	188.2478	(219)
Water heating fuel used												1922.0236	(219)

Annual totals kWh/year		
Space heating fuel - main system	4845.1287	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) = -1278.1572	-1278.1572	(233)
Total delivered energy for all uses	5980.0746	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4845.1287	0.2160	1046.5478	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.0236	0.2160	415.1571	(264)
Space and water heating			1461.7049	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1053.2115	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.0000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.0000	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		28.3484	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.3484	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.1800	20.6388			(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.1800	3.0942			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.0528			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5562	(36)
Total fabric heat loss (33) + (36) =	67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462 (64)
									Total per year (kWh/year) = Sum(64)m =			2122.4678 (64)
Heat gains from water heating, kWh/month												
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772	(83)
Total gains	533.7078	608.3817	669.7815	726.0139	761.6960	744.0053	709.9268	669.3371	627.3704	570.0222	521.1234	505.6162	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9985	0.9970	0.9929	0.9792	0.9357	0.8206	0.6610	0.7131	0.9090	0.9854	0.9971	0.9989	(86)
MIT	19.6160	19.7601	20.0026	20.3359	20.6537	20.8869	20.9706	20.9575	20.7889	20.3840	19.9448	19.5964	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9980	0.9959	0.9902	0.9703	0.9050	0.7351	0.5210	0.5777	0.8531	0.9776	0.9958	0.9985	(89)
MIT 2	18.0535	18.2661	18.6215	19.1125	19.5557	19.8481	19.9195	19.9142	19.7421	19.1876	18.5462	18.0328	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9938	0.9862	0.9633	0.8979	0.7421	0.5419	0.5972	0.8514	0.9717	0.9938	0.9976	(94)
Useful gains	532.0236	604.5960	660.5534	699.3443	683.8904	552.1036	384.7414	399.7568	534.1382	553.8897	517.8729	504.3851	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1645.0618	1593.4639	1441.2580	1198.3354	922.0806	613.6516	394.9410	415.9385	661.6907	1007.9209	1347.2259	1635.0137	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating												4386.0721	(98)
Space heating per m2											(98) / (4) =	45.8267	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4696.0086	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	886.6171	711.4767	621.8889	384.6613	189.7361	0.0000	0.0000	0.0000	0.0000	361.6694	639.3299	900.6292	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1470	87.9782	87.6238	86.8421	85.1852	80.3000	80.3000	80.3000	80.3000	86.5884	87.7134	88.2160	(217)
Fuel for water heating, kWh/month													
	239.6027	211.6176	223.2056	199.8567	197.2602	184.3053	176.5785	196.8436	199.0176	210.0470	219.1474	233.6834	(219)
Water heating fuel used												2491.1657	(219)
Annual totals kWh/year													
Space heating fuel - main system												4696.0086	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7678.2537	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4696.0086	0.2160	1014.3379	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2491.1657	0.2160	538.0918	(264)
Space and water heating			1552.4296	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1807.2998	(272)
Emissions per m2 for space and water heating			16.2201	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2201 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.8800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.3673	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3673	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4683	0.4591	0.4499	0.4040	0.3948	0.3489	0.3489	0.3397	0.3673	0.3948	0.4132	0.4315	(22b)
Effective ac	0.6096	0.6054	0.6012	0.5816	0.5779	0.5609	0.5609	0.5577	0.5674	0.5779	0.5854	0.5931	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.7734	49.4258	49.0851	47.4849	47.1856	45.7918	45.7918	45.5337	46.3287	47.1856	47.7912	48.4244	(38)
Heat transfer coeff	123.3861	123.0386	122.6979	121.0977	120.7983	119.4046	119.4046	119.1465	119.9414	120.7983	121.4040	122.0372	(39)
Average = Sum(39)m / 12 =												121.0963	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2892	1.2855	1.2820	1.2653	1.2621	1.2476	1.2476	1.2449	1.2532	1.2621	1.2685	1.2751	(40)
HLP (average)												1.2652	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	504.5541	592.2872	667.5555	739.6617	787.2599	773.4361	738.1715	687.0256	634.7718	561.2557	497.3894	474.8151	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.3485	36.4512	36.5524	37.0354	37.1272	37.5605	37.5605	37.6419	37.3924	37.1272	36.9420	36.7503	
alpha	3.4232	3.4301	3.4368	3.4690	3.4751	3.5040	3.5040	3.5095	3.4928	3.4751	3.4628	3.4500	
util living area													
	0.9939	0.9888	0.9782	0.9515	0.8908	0.7733	0.6322	0.6835	0.8675	0.9654	0.9897	0.9951	(86)
MIT	19.0086	19.2163	19.5592	20.0218	20.4573	20.7857	20.9243	20.8987	20.6433	20.0816	19.4658	18.9780	(87)
Th 2	19.8493	19.8522	19.8550	19.8681	19.8706	19.8821	19.8821	19.8843	19.8777	19.8706	19.8656	19.8604	(88)
util rest of house													
	0.9924	0.9860	0.9724	0.9373	0.8551	0.6930	0.5022	0.5587	0.8102	0.9526	0.9867	0.9938	(89)
MIT 2	18.0383	18.2469	18.5890	19.0525	19.4672	19.7599	19.8548	19.8439	19.6475	19.1183	18.5063	18.0159	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1859	18.3944	18.7366	19.2000	19.6178	19.9160	20.0175	20.0044	19.7990	19.2649	18.6522	18.1623	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1859	18.3944	18.7366	19.2000	19.6178	19.9160	20.0175	20.0044	19.7990	19.2649	18.6522	18.1623	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9811	0.9648	0.9265	0.8454	0.6958	0.5195	0.5739	0.8053	0.9433	0.9820	0.9912	(94)
Useful gains	499.1109	581.0684	644.0397	685.2652	665.5184	538.1215	383.4942	394.2679	511.1623	529.4542	488.4397	470.6306	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1713.3313	1660.3324	1501.4020	1247.3019	956.4591	634.7497	408.0611	429.4480	683.5442	1046.7000	1402.4865	1703.9161	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	903.3800	725.2655	637.8776	404.6665	216.4599	0.0000	0.0000	0.0000	0.0000	384.8309	658.1137	917.5644	(98)
Space heating												4848.1583	(98)
Space heating per m2											(98) / (4) =	50.6547	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1122.4030	883.5939	905.5133	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7341	0.8105	0.7785	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	823.9519	716.1411	704.9072	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1881	963.8191	906.0197	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	131.9301	184.2725	149.6277	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												465.8303	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	32.9825	46.0681	37.4069	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												116.4576	(107)
Space cooling per m2												1.2168	(108)
Energy for space heating												50.6547	(99)
Energy for space cooling												1.2168	(108)
Total												51.8714	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.1800	20.6388			(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.1800	3.0942			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961	(42)
Average daily hot water use (litres/day)	98.2325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243 (72)

Total internal gains

	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772 (83)
Total gains	487.7388	563.2316	626.3320	685.5155	723.3715	708.4671	676.1850	632.6207	589.1634	528.7832	477.1824	460.4627 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area	0.9990	0.9978	0.9946	0.9834	0.9460	0.8409	0.6861	0.7415	0.9253	0.9893	0.9980	0.9993	(86)
MIT	19.5718	19.7170	19.9618	20.3002	20.6261	20.8725	20.9654	20.9494	20.7645	20.3465	19.9027	19.5528	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house	0.9987	0.9971	0.9925	0.9761	0.9189	0.7592	0.5445	0.6063	0.8759	0.9833	0.9972	0.9990	(89)
MIT 2	18.5943	18.7416	18.9879	19.3333	19.6471	19.8657	19.9215	19.9173	19.7820	19.3835	18.9383	18.5845	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9960	0.9905	0.9722	0.9150	0.7671	0.5661	0.6264	0.8762	0.9802	0.9962	0.9986	(94)
Useful gains	486.8312	560.9916	620.3711	666.4239	661.8783	543.4498	382.7621	396.2456	516.2265	518.3250	475.3671	459.8187	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1698.1893	1639.9559	1476.8370	1219.2851	930.5096	615.0903	395.0508	416.0966	665.1267	1026.3540	1384.9004	1688.5901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	901.2504	725.0640	637.2106	398.0601	199.8617	0.0000	0.0000	0.0000	0.0000	377.9736	654.8639	914.2059	(98)
Space heating												4808.4902	(98)
Space heating per m2											(98) / (4) =	50.2402	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7696	0.8543	0.8219	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	821.1529	717.5810	707.3429	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	931.2502	891.3674	842.4295	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	79.2701	129.2970	100.5044	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												309.0716 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	19.8175	32.3243	25.1261	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												77.2679 (107)
Space cooling per m2												0.8073 (108)
Energy for space heating												50.2402 (99)
Energy for space cooling												0.8073 (108)
Total												51.0475 (109)
Target Fabric Energy Efficiency (TFEE)												58.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4077	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4281	0.3975	0.4077	0.3873	0.3873	0.3771	0.3669	0.3567	0.3465	0.3771	0.3567	0.3771	(22b)
Effective ac	0.5916	0.5790	0.5831	0.5750	0.5750	0.5711	0.5673	0.5636	0.5600	0.5711	0.5636	0.5711	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3027	47.2723	47.6073	46.9458	46.9458	46.6278	46.3182	46.0172	45.7246	46.6278	46.0172	46.6278	(38)
Heat transfer coeff	121.9155	120.8851	121.2201	120.5585	120.5585	120.2405	119.9310	119.6299	119.3373	120.2405	119.6299	120.2405	(39)
Average = Sum(39)m / 12 =												120.3656	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2738	1.2630	1.2665	1.2596	1.2596	1.2563	1.2531	1.2499	1.2469	1.2563	1.2499	1.2563	(40)
HLP (average)												1.2576	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918	(83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7870	37.1005	36.9980	37.2010	37.2010	37.2994	37.3957	37.4898	37.5817	37.2994	37.4898	37.2994	
alpha	3.4525	3.4734	3.4665	3.4801	3.4801	3.4866	3.4930	3.4993	3.5054	3.4866	3.4993	3.4866	
util living area													
	0.9757	0.9667	0.9431	0.8891	0.7879	0.6088	0.4643	0.4825	0.7202	0.8951	0.9589	0.9788	(86)
MIT	19.4457	19.5991	19.9221	20.3363	20.6908	20.9116	20.9742	20.9711	20.8346	20.4320	19.9071	19.4402	(87)
Th 2	19.8614	19.8699	19.8671	19.8726	19.8726	19.8752	19.8778	19.8803	19.8827	19.8752	19.8803	19.8752	(88)
util rest of house													
	0.9700	0.9591	0.9294	0.8609	0.7308	0.5115	0.3399	0.3547	0.6339	0.8617	0.9477	0.9738	(89)
MIT 2	17.8373	18.0632	18.5232	19.1046	19.5689	19.8149	19.8677	19.8688	19.7511	19.2481	18.5166	17.8389	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.0820	18.2969	18.7360	19.2919	19.7396	19.9818	20.0360	20.0365	19.9159	19.4282	18.7282	18.0825	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9320	18.1469	18.5860	19.1419	19.5896	19.8318	19.8860	19.8865	19.7659	19.2782	18.5782	17.9325	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9427	0.9088	0.8383	0.7142	0.5074	0.3408	0.3555	0.6236	0.8391	0.9295	0.9610	(94)
Useful gains	735.3175	787.8610	826.4394	820.6533	711.0806	514.0161	328.6944	327.1994	539.9612	668.4171	697.3894	699.3021	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1588.8036	1552.9977	1404.4535	1162.4187	854.7076	544.9035	334.1265	333.3447	604.5564	947.2734	1277.4268	1555.0066	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	634.9937	514.1719	430.0424	246.0711	106.8585	0.0000	0.0000	0.0000	0.0000	207.4691	417.6270	636.6441	(98)
Space heating												3193.8778	(98)
RHI space heating demand												3194	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4077	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5198	0.5096	0.4994	0.4484	0.4383	0.3873	0.3873	0.3771	0.4077	0.4383	0.4586	0.4790	(22b)
Effective ac	0.6351	0.6298	0.6247	0.6006	0.5960	0.5750	0.5750	0.5711	0.5831	0.5960	0.6052	0.6147	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8520	51.4237	51.0039	49.0321	48.6632	46.9458	46.9458	46.6278	47.6073	48.6632	49.4095	50.1897	(38)
Heat transfer coeff	125.4647	125.0364	124.6166	122.6448	122.2759	120.5585	120.5585	120.2405	121.2201	122.2759	123.0222	123.8025	(39)
Average = Sum(39)m / 12 =												122.6431	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3109	1.3064	1.3020	1.2814	1.2776	1.2596	1.2596	1.2563	1.2665	1.2776	1.2854	1.2935	(40)
HLP (average)												1.2814	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7463	35.8687	35.9896	36.5682	36.6785	37.2010	37.2010	37.2994	36.9980	36.6785	36.4560	36.2262	
alpha	3.3831	3.3912	3.3993	3.4379	3.4452	3.4801	3.4801	3.4866	3.4665	3.4452	3.4304	3.4151	
util living area													
	0.9806	0.9708	0.9523	0.9108	0.8293	0.6891	0.5417	0.5836	0.7827	0.9229	0.9700	0.9834	(86)
MIT	19.2603	19.4578	19.7774	20.2036	20.5830	20.8517	20.9524	20.9376	20.7524	20.2747	19.7025	19.2315	(87)
Th 2	19.8323	19.8358	19.8392	19.8554	19.8584	19.8726	19.8726	19.8752	19.8671	19.8584	19.8523	19.8459	(88)
util rest of house													
	0.9762	0.9641	0.9408	0.8878	0.7824	0.6025	0.4195	0.4627	0.7094	0.8984	0.9619	0.9796	(89)
MIT 2	17.5509	17.8379	18.2993	18.9113	19.4234	19.7560	19.8491	19.8417	19.6495	19.0227	18.2054	17.5177	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8109	18.0843	18.5242	19.1079	19.5999	19.9227	20.0170	20.0084	19.8173	19.2131	18.4331	17.7784	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6609	17.9343	18.3742	18.9579	19.4499	19.7727	19.8670	19.8584	19.6673	19.0631	18.2831	17.6284	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9484	0.9209	0.8647	0.7624	0.5939	0.4188	0.4607	0.6942	0.8757	0.9459	0.9684	(94)
Useful gains	713.7701	782.2211	818.9608	818.0800	746.1099	565.5790	381.4837	398.3709	570.8264	669.2103	677.7935	683.3319	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1676.3232	1629.7656	1479.7196	1233.5469	947.6200	623.6116	393.8596	415.8394	674.8666	1034.8388	1375.7759	1662.4678	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	716.1395	569.5499	491.6045	299.1361	149.9235	0.0000	0.0000	0.0000	0.0000	272.0276	502.5473	728.4772	(98)
Space heating												3729.4057	(98)
Space heating per m2											(98) / (4) =	38.9657	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4120.8903	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	716.1395	569.5499	491.6045	299.1361	149.9235	0.0000	0.0000	0.0000	0.0000	272.0276	502.5473	728.4772	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	791.3144	629.3369	543.2094	330.5372	165.6614	0.0000	0.0000	0.0000	0.0000	300.5829	555.3009	804.9471	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8550	89.8033	89.6975	89.4562	88.9550	87.3000	87.3000	87.3000	87.3000	89.3612	89.7188	89.8787	(217)
Fuel for water heating, kWh/month													
	194.0734	170.2740	176.9569	156.1539	151.7693	135.0886	126.8064	143.1997	144.2255	162.2497	174.5034	188.3832	(219)
Water heating fuel used												1923.6840	(219)
Annual totals kWh/year													
Space heating fuel - main system												4120.8903	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5257.4965	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4120.8903	3.4800	143.4070	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.6840	3.4800	66.9442	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			226.5356	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6762	(257)
SAP value		90.5673	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4120.8903	0.2160	890.1123	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.6840	0.2160	415.5157	(264)
Space and water heating			1305.6280	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			897.1347	(272)
CO2 emissions per m2			9.3700	(273)
EI value			91.4565	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4077	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4281	0.3975	0.4077	0.3873	0.3873	0.3771	0.3669	0.3567	0.3465	0.3771	0.3567	0.3771	(22b)
Effective ac	0.5916	0.5790	0.5831	0.5750	0.5750	0.5711	0.5673	0.5636	0.5600	0.5711	0.5636	0.5711	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3027	47.2723	47.6073	46.9458	46.9458	46.6278	46.3182	46.0172	45.7246	46.6278	46.0172	46.6278	(38)
Heat transfer coeff	121.9155	120.8851	121.2201	120.5585	120.5585	120.2405	119.9310	119.6299	119.3373	120.2405	119.6299	120.2405	(39)
Average = Sum(39)m / 12 =												120.3656	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2738	1.2630	1.2665	1.2596	1.2596	1.2563	1.2531	1.2499	1.2469	1.2563	1.2499	1.2563	(40)
HLP (average)												1.2576	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918	(83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7870	37.1005	36.9980	37.2010	37.2010	37.2994	37.3957	37.4898	37.5817	37.2994	37.4898	37.2994	
alpha	3.4525	3.4734	3.4665	3.4801	3.4801	3.4866	3.4930	3.4993	3.5054	3.4866	3.4993	3.4866	
util living area													
	0.9757	0.9667	0.9431	0.8891	0.7879	0.6088	0.4643	0.4825	0.7202	0.8951	0.9589	0.9788	(86)
MIT	19.4457	19.5991	19.9221	20.3363	20.6908	20.9116	20.9742	20.9711	20.8346	20.4320	19.9071	19.4402	(87)
Th 2	19.8614	19.8699	19.8671	19.8726	19.8726	19.8752	19.8778	19.8803	19.8827	19.8752	19.8803	19.8752	(88)
util rest of house													
	0.9700	0.9591	0.9294	0.8609	0.7308	0.5115	0.3399	0.3547	0.6339	0.8617	0.9477	0.9738	(89)
MIT 2	17.8373	18.0632	18.5232	19.1046	19.5689	19.8149	19.8677	19.8688	19.7511	19.2481	18.5166	17.8389	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.0820	18.2969	18.7360	19.2919	19.7396	19.9818	20.0360	20.0365	19.9159	19.4282	18.7282	18.0825	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9320	18.1469	18.5860	19.1419	19.5896	19.8318	19.8860	19.8865	19.7659	19.2782	18.5782	17.9325	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9427	0.9088	0.8383	0.7142	0.5074	0.3408	0.3555	0.6236	0.8391	0.9295	0.9610	(94)
Useful gains	735.3175	787.8610	826.4394	820.6533	711.0806	514.0161	328.6944	327.1994	539.9612	668.4171	697.3894	699.3021	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1588.8036	1552.9977	1404.4535	1162.4187	854.7076	544.9035	334.1265	333.3447	604.5564	947.2734	1277.4268	1555.0066	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	634.9937	514.1719	430.0424	246.0711	106.8585	0.0000	0.0000	0.0000	0.0000	207.4691	417.6270	636.6441	(98)
Space heating												3193.8778	(98)
Space heating per m2											(98) / (4) =	33.3704	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3529.1468	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	634.9937	514.1719	430.0424	246.0711	106.8585	0.0000	0.0000	0.0000	0.0000	207.4691	417.6270	636.6441	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	701.6505	568.1457	475.1850	271.9018	118.0757	0.0000	0.0000	0.0000	0.0000	229.2476	461.4663	703.4742	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7909	89.7459	89.6144	89.3145	88.6854	87.3000	87.3000	87.3000	87.3000	89.1557	89.6044	89.8084	(217)
Fuel for water heating, kWh/month													
	194.2121	170.3828	177.1209	156.4016	152.2306	135.0886	126.8064	143.1997	144.2255	162.6237	174.7262	188.5306	(219)
Water heating fuel used												1925.5487	(219)
Annual totals kWh/year													
Space heating fuel - main system												3529.1468	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4515.3240	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3529.1468	10.2300	361.0317	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1925.5487	10.2300	196.9836	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			316.0781	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3529.1468	0.2160	762.2957	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.5487	0.2160	415.9185	(264)
Space and water heating			1178.2142	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			690.6804	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3529.1468	1.2200	4305.5591	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.5487	1.2200	2349.1694	(264)
Space and water heating			6654.7285	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/year 3770.8581 (272)
Primary energy kWh/m2/year 39.3988 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-192 kg (27.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.00 kg/m²	A 92	A 93
Total Savings	£85	2.00 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£180	£199	-£18
Mains gas	£661	£558	£103
Space heating	£492	£492	£0
Water heating	£197	£112	£85
Lighting	£153	£153	£0
Generated (PV)	-£525	-£525	£0
Total cost of fuels	£316	£232	£85
Total cost of uses	£317	£232	£85
Delivered energy	47 kWh/m²	37 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	39 kWh/m²	28 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4077	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5198	0.5096	0.4994	0.4484	0.4383	0.3873	0.3873	0.3771	0.4077	0.4383	0.4586	0.4790	(22b)
Effective ac	0.6351	0.6298	0.6247	0.6006	0.5960	0.5750	0.5750	0.5711	0.5831	0.5960	0.6052	0.6147	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8520	51.4237	51.0039	49.0321	48.6632	46.9458	46.9458	46.6278	47.6073	48.6632	49.4095	50.1897	(38)
Heat transfer coeff	125.4647	125.0364	124.6166	122.6448	122.2759	120.5585	120.5585	120.2405	121.2201	122.2759	123.0222	123.8025	(39)
Average = Sum(39)m / 12 =												122.6431	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3109	1.3064	1.3020	1.2814	1.2776	1.2596	1.2596	1.2563	1.2665	1.2776	1.2854	1.2935	(40)
HLP (average)												1.2814	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961	(42)
Average daily hot water use (litres/day)	98.2325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1734	(H8)
Utilisation factor												0.5735	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-865.2421	(H17)
Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963	(63)
								Solar input (sum of months) = Sum(63)m =				-865.2421	(63)
Output from w/h													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
								Total per year (kWh/year) = Sum(64)m =				849.7380	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7463	35.8687	35.9896	36.5682	36.6785	37.2010	37.2010	37.2994	36.9980	36.6785	36.4560	36.2262	
alpha	3.3831	3.3912	3.3993	3.4379	3.4452	3.4801	3.4801	3.4866	3.4665	3.4452	3.4304	3.4151	
util living area													
	0.9806	0.9708	0.9523	0.9108	0.8293	0.6891	0.5417	0.5836	0.7827	0.9229	0.9700	0.9834	(86)
MIT	19.2603	19.4578	19.7774	20.2036	20.5830	20.8517	20.9524	20.9376	20.7524	20.2747	19.7025	19.2315	(87)
Th 2	19.8323	19.8358	19.8392	19.8554	19.8584	19.8726	19.8726	19.8752	19.8671	19.8584	19.8523	19.8459	(88)
util rest of house													
	0.9762	0.9641	0.9408	0.8878	0.7824	0.6025	0.4195	0.4627	0.7094	0.8984	0.9619	0.9796	(89)
MIT 2	17.5509	17.8379	18.2993	18.9113	19.4234	19.7560	19.8491	19.8417	19.6495	19.0227	18.2054	17.5177	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8109	18.0843	18.5242	19.1079	19.5999	19.9227	20.0170	20.0084	19.8173	19.2131	18.4331	17.7784	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6609	17.9343	18.3742	18.9579	19.4499	19.7727	19.8670	19.8584	19.6673	19.0631	18.2831	17.6284	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9484	0.9209	0.8647	0.7624	0.5939	0.4188	0.4607	0.6942	0.8757	0.9459	0.9684	(94)
Useful gains	713.7701	782.2211	818.9608	818.0800	746.1099	565.5790	381.4837	398.3709	570.8264	669.2103	677.7935	683.3319	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1676.3232	1629.7656	1479.7196	1233.5469	947.6200	623.6116	393.8596	415.8394	674.8666	1034.8388	1375.7759	1662.4678	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	716.1395	569.5499	491.6045	299.1361	149.9235	0.0000	0.0000	0.0000	0.0000	272.0276	502.5473	728.4772	(98)
Space heating												3729.4057	(98)
Space heating per m2											(98) / (4) =	38.9657	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4120.8903	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	716.1395	569.5499	491.6045	299.1361	149.9235	0.0000	0.0000	0.0000	0.0000	272.0276	502.5473	728.4772	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	791.3144	629.3369	543.2094	330.5372	165.6614	0.0000	0.0000	0.0000	0.0000	300.5829	555.3009	804.9471	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9313	89.9620	90.0019	90.0756	90.1644	87.3000	87.3000	87.3000	87.3000	89.6729	89.8365	89.9423	(217)
Fuel for water heating, kWh/month	166.0093	123.4335	97.1303	48.9857	18.7920	2.1281	0.0000	28.5666	54.4449	101.9984	141.1471	164.9058	(219)
Water heating fuel used												947.5416	(219)
Annual totals kWh/year													
Space heating fuel - main system												4120.8903	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4331.3541	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4120.8903	3.4800	143.4070	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.5416	3.4800	32.9744	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			199.1609	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5945	(257)
SAP value	91.7072	
SAP rating (Section 12)	92	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4120.8903	0.2160	890.1123	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.5416	0.2160	204.6690	(264)
Space and water heating			1094.7813	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			712.2379	(272)
CO2 emissions per m2			7.4400	(273)
EI value			93.2173	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4077	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4281	0.3975	0.4077	0.3873	0.3873	0.3771	0.3669	0.3567	0.3465	0.3771	0.3567	0.3771	(22b)
Effective ac	0.5916	0.5790	0.5831	0.5750	0.5750	0.5711	0.5673	0.5636	0.5600	0.5711	0.5636	0.5711	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3027	47.2723	47.6073	46.9458	46.9458	46.6278	46.3182	46.0172	45.7246	46.6278	46.0172	46.6278	(38)
Heat transfer coeff	121.9155	120.8851	121.2201	120.5585	120.5585	120.2405	119.9310	119.6299	119.3373	120.2405	119.6299	120.2405	(39)
Average = Sum(39)m / 12 =												120.3656	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2738	1.2630	1.2665	1.2596	1.2596	1.2563	1.2531	1.2499	1.2469	1.2563	1.2499	1.2563	(40)
HLP (average)												1.2576	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3132	(H8)
Utilisation factor												0.5330	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-899.9506	(H17)
Solar input	-29.3586	-41.7460	-71.7514	-96.8092	-113.7082	-121.4583	-118.9041	-106.4227	-83.3217	-57.6057	-34.7234	-24.1413	(63)
								Solar input (sum of months) = Sum(63)m =				-899.9506	(63)
Output from w/h													
	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)
								Total per year (kWh/year) = Sum(64)m =				822.9189	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	13.4839	0.4600	0.0000	0.7700	20.5845	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	5.0600	56.7559	0.4600	0.0000	0.7700	101.7208	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
North	3.3300	13.4839	0.4600	0.0000	0.7700	15.9041	(74)

Solar gains	151.0588	222.7099	320.6132	427.6717	482.7017	534.3979	505.4121	452.4012	376.0171	269.0858	181.0377	126.6918	(83)
Total gains	769.0603	835.7121	909.3993	978.9949	995.5853	1013.0968	964.3515	920.4580	865.8428	796.5987	750.3207	727.6555	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7870	37.1005	36.9980	37.2010	37.2010	37.2994	37.3957	37.4898	37.5817	37.2994	37.4898	37.2994	
alpha	3.4525	3.4734	3.4665	3.4801	3.4801	3.4866	3.4930	3.4993	3.5054	3.4866	3.4993	3.4866	
util living area													
	0.9757	0.9667	0.9431	0.8891	0.7879	0.6088	0.4643	0.4825	0.7202	0.8951	0.9589	0.9788	(86)
MIT	19.4457	19.5991	19.9221	20.3363	20.6908	20.9116	20.9742	20.9711	20.8346	20.4320	19.9071	19.4402	(87)
Th 2	19.8614	19.8699	19.8671	19.8726	19.8726	19.8752	19.8778	19.8803	19.8827	19.8752	19.8803	19.8752	(88)
util rest of house													
	0.9700	0.9591	0.9294	0.8609	0.7308	0.5115	0.3399	0.3547	0.6339	0.8617	0.9477	0.9738	(89)
MIT 2	17.8373	18.0632	18.5232	19.1046	19.5689	19.8149	19.8677	19.8688	19.7511	19.2481	18.5166	17.8389	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.0820	18.2969	18.7360	19.2919	19.7396	19.9818	20.0360	20.0365	19.9159	19.4282	18.7282	18.0825	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9320	18.1469	18.5860	19.1419	19.5896	19.8318	19.8860	19.8865	19.7659	19.2782	18.5782	17.9325	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9427	0.9088	0.8383	0.7142	0.5074	0.3408	0.3555	0.6236	0.8391	0.9295	0.9610	(94)
Useful gains	735.3175	787.8610	826.4394	820.6533	711.0806	514.0161	328.6944	327.1994	539.9612	668.4171	697.3894	699.3021	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1588.8036	1552.9977	1404.4535	1162.4187	854.7076	544.9035	334.1265	333.3447	604.5564	947.2734	1277.4268	1555.0066	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	634.9937	514.1719	430.0424	246.0711	106.8585	0.0000	0.0000	0.0000	0.0000	207.4691	417.6270	636.6441	(98)
Space heating												3193.8778	(98)
Space heating per m2											(98) / (4) =	33.3704	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3529.1468	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	634.9937	514.1719	430.0424	246.0711	106.8585	0.0000	0.0000	0.0000	0.0000	207.4691	417.6270	636.6441	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	701.6505	568.1457	475.1850	271.9018	118.0757	0.0000	0.0000	0.0000	0.0000	229.2476	461.4663	703.4742	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8874	89.9141	89.9454	90.0104	89.9520	87.3000	87.3000	87.3000	87.3000	89.5274	89.7569	89.8882	(217)
Fuel for water heating, kWh/month	161.3420	123.6354	96.6971	47.6391	23.6773	0.0000	0.0000	21.2950	48.7826	97.6041	135.7432	161.5063	(219)
Water heating fuel used												917.9221	(219)
Annual totals kWh/year													
Space heating fuel - main system												3529.1468	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												3557.6974	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3529.1468	10.2300	361.0317	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	917.9221	10.2300	93.9034	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			231.3579	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3529.1468	0.2160	762.2957	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9221	0.2160	198.2712	(264)
Space and water heating			960.5669	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

Energy saving/generation technologies			
PV Unit	-1430.4508	0.5190	-742.4040 (269)
Total kg/year			498.9831 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3529.1468	1.2200	4305.5591	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9221	1.2200	1119.8650	(264)
Space and water heating			5425.4240	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			2695.0537	(272)
Primary energy kWh/m2/year			28.1585	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	326.58 (P1)
Transmission heat loss coefficient	73.61 (37)
Summer heat loss coefficient	400.19 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.3100	87.1704	0.4600	0.0000	0.9000	155.5417
East	0.7200	125.2818	0.4600	0.0000	0.9000	37.3440
South	5.0600	118.5567	0.4600	0.0000	0.9000	248.3573
West	0.7200	125.2818	0.4600	0.0000	0.9000	37.3440
North	3.3300	87.1704	0.4600	0.0000	0.9000	120.1749
total:						598.7619

	Jun	Jul	Aug	
Solar gains	644	599	534	(P4)
Internal gains	476	456	465	
Total summer gains	1119	1055	999	(P5)
Summer gain/loss ratio	2.80	2.64	2.50	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.02	20.75	20.62	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-323	**Issued on Date**	06/07/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-As-DET
Property	15, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	90 B	**DER**	11.37	**TER**	19.00
Environmental	91 B	**% DER<TER**	40.15		
CO_2 Emissions (t/year)	0.77	**DFEE**	53.18	**TFEE**	60.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.50		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.37 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.2 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.72 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 6.36 m², No overhang
Windows facing North West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	542.6957	633.1929	724.0748	823.7343	895.9616	887.3742	843.5044	773.9488	695.3660	601.4748	532.7547	511.6465	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9921	0.9864	0.9735	0.9399	0.8667	0.7375	0.5978	0.6544	0.8523	0.9602	0.9873	0.9935	(86)
MIT	18.8850	19.1003	19.4740	19.9882	20.4550	20.7911	20.9252	20.8976	20.6260	20.0244	19.3747	18.8612	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9903	0.9831	0.9667	0.9233	0.8268	0.6545	0.4701	0.5302	0.7924	0.9462	0.9837	0.9920	(89)
MIT 2	17.0086	17.3242	17.8685	18.6156	19.2605	19.6912	19.8243	19.8070	19.5052	18.6801	17.7367	16.9827	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3350	17.6331	18.1477	18.8543	19.4683	19.8825	20.0158	19.9967	19.7001	18.9139	18.0217	17.3094	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1850	17.4831	17.9977	18.7043	19.3183	19.7325	19.8658	19.8467	19.5501	18.7639	17.8717	17.1594	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9730	0.9512	0.9011	0.8040	0.6434	0.4704	0.5277	0.7719	0.9269	0.9740	0.9862	(94)
Useful gains	533.7172	616.0733	688.7619	742.2978	720.3584	570.9368	396.7443	408.4509	536.7441	557.4891	518.8929	504.5811	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1723.2423	1676.6191	1526.3999	1279.1612	990.6853	657.2062	418.1802	440.0732	702.0637	1061.6450	1410.0821	1708.2051	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	885.0067	712.6868	623.2027	386.5417	201.1232	0.0000	0.0000	0.0000	0.0000	375.0919	641.6562	895.4963	(98)
Space heating												4720.8054	(98)
Space heating per m2											(98) / (4) =	46.8427	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5216.3595	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	885.0067	712.6868	623.2027	386.5417	201.1232	0.0000	0.0000	0.0000	0.0000	375.0919	641.6562	895.4963	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	977.9079	787.4992	688.6217	427.1179	222.2356	0.0000	0.0000	0.0000	0.0000	414.4662	709.0124	989.4987	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9522	89.9124	89.8257	89.6209	89.1785	87.3000	87.3000	87.3000	87.3000	89.5774	89.8482	89.9707	(217)
Fuel for water heating, kWh/month													
	196.0452	171.9760	178.6758	157.5935	153.0536	136.5557	128.1658	144.7599	145.8047	163.6477	176.1996	190.3027	(219)
Water heating fuel used												1942.7803	(219)
Annual totals kWh/year													
Space heating fuel - main system												5216.3595	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												6387.1652	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5216.3595	0.2160	1126.7337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.7803	0.2160	419.6405	(264)
Space and water heating			1546.3742	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1145.7194	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.3700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.3700	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		28.3505	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.3505	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	539.1184	616.8825	693.1714	775.2908	833.4163	821.9774	781.9754	723.5233	658.1885	581.0773	525.7569	510.5522	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9988	0.9974	0.9934	0.9785	0.9289	0.8034	0.6430	0.7046	0.9121	0.9874	0.9976	0.9991	(86)
MIT	19.5673	19.7123	19.9684	20.3279	20.6622	20.8951	20.9730	20.9585	20.7798	20.3535	19.9045	19.5517	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9983	0.9965	0.9909	0.9692	0.8957	0.7148	0.5034	0.5682	0.8570	0.9805	0.9965	0.9987	(89)
MIT 2	17.9705	18.1848	18.5606	19.0909	19.5550	19.8446	19.9095	19.9041	19.7214	19.1347	18.4775	17.9570	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9947	0.9872	0.9623	0.8897	0.7248	0.5275	0.5911	0.8564	0.9752	0.9948	0.9979	(94)
Useful gains	537.6747	613.5855	684.3288	746.0702	741.4647	595.7993	412.5302	427.6983	563.6486	566.6719	523.0059	509.5018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1757.2657	1701.1671	1539.5380	1280.7310	987.4014	656.2952	422.5673	444.6968	705.9830	1073.1773	1435.3719	1744.0559	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating												4794.6907	(98)
Space heating per m2											(98) / (4) =	47.5758	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5133.5018	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	971.4943	782.4998	681.2373	412.1582	195.9068	0.0000	0.0000	0.0000	0.0000	403.4689	703.3228	983.4136	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2876	88.1330	87.7861	86.9721	85.2353	80.3000	80.3000	80.3000	80.3000	86.8241	87.8802	88.3479	(217)
Fuel for water heating, kWh/month													
	241.4382	213.1885	224.8054	201.9957	199.5525	186.5567	178.7355	199.2482	201.4487	211.3188	220.7179	235.4804	(219)
Water heating fuel used												2514.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												5133.5018	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8154.1709	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5133.5018	0.2160	1108.8364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2514.4865	0.2160	543.1291	(264)
Space and water heating			1651.9655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1914.6742	(272)
Emissions per m2 for space and water heating			16.3918	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3918 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			19.0000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.3895	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3895	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4967	0.4869	0.4772	0.4285	0.4188	0.3701	0.3701	0.3603	0.3895	0.4188	0.4382	0.4577	(22b)
Effective ac	0.6233	0.6185	0.6139	0.5918	0.5877	0.5685	0.5685	0.5649	0.5759	0.5877	0.5960	0.6047	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.5886	53.1769	52.7733	50.8776	50.5230	48.8719	48.8719	48.5662	49.5079	50.5230	51.2405	51.9906	(38)
Heat transfer coeff	131.5477	131.1359	130.7323	128.8367	128.4820	126.8310	126.8310	126.5252	127.4669	128.4820	129.1995	129.9496	(39)
Average = Sum(39)m / 12 =												128.8350	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3053	1.3012	1.2972	1.2784	1.2749	1.2585	1.2585	1.2555	1.2648	1.2749	1.2820	1.2894	(40)
HLP (average)												1.2784	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	508.7810	600.1113	692.7231	794.7373	868.4953	862.0607	820.0174	748.1180	668.6997	572.3718	500.9029	478.5613	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9953	34.1020	34.2073	34.7106	34.8064	35.2595	35.2595	35.3447	35.0836	34.8064	34.6131	34.4133	
alpha	3.2664	3.2735	3.2805	3.3140	3.3204	3.3506	3.3506	3.3563	3.3389	3.3204	3.3075	3.2942	
util living area													
	0.9935	0.9883	0.9763	0.9444	0.8734	0.7465	0.6069	0.6661	0.8620	0.9649	0.9894	0.9947	(86)
MIT	18.8783	19.0936	19.4675	19.9792	20.4485	20.7865	20.9233	20.8938	20.6159	20.0092	19.3595	18.8502	(87)
Th 2	19.8367	19.8399	19.8430	19.8578	19.8606	19.8735	19.8735	19.8759	19.8685	19.8606	19.8550	19.8491	(88)
util rest of house													
	0.9920	0.9855	0.9703	0.9289	0.8350	0.6647	0.4794	0.5427	0.8046	0.9523	0.9864	0.9935	(89)
MIT 2	17.9060	18.1224	18.4953	19.0073	19.4520	19.7519	19.8454	19.8329	19.6186	19.0457	18.3992	17.8869	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0751	18.2914	18.6644	19.1764	19.6253	19.9319	20.0329	20.0175	19.7921	19.2133	18.5663	18.0545	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0751	18.2914	18.6644	19.1764	19.6253	19.9319	20.0329	20.0175	19.7921	19.2133	18.5663	18.0545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9802	0.9620	0.9172	0.8255	0.6695	0.4991	0.5601	0.7999	0.9426	0.9815	0.9906	(94)
Useful gains	502.9807	588.2370	666.3758	728.9229	716.9742	577.1666	409.2532	418.9955	534.8724	539.5165	491.6346	474.0777	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1812.0858	1756.0887	1590.2844	1323.9763	1018.2648	676.2454	435.4027	457.7008	725.5516	1106.6530	1481.4356	1800.3828	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	973.9742	784.7964	687.3880	428.4384	224.1603	0.0000	0.0000	0.0000	0.0000	421.9495	712.6567	986.7710	(98)
Space heating												5220.1345	(98)
Space heating per m2											(98) / (4) =	51.7973	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1192.2110	938.5491	961.5916	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7433	0.8154	0.7779	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	886.1273	765.2566	747.9740	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.7326	1062.3591	980.3929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.8759	221.0443	172.9196	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												557.8398	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	40.9690	55.2611	43.2299	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												139.4599	(107)
Space cooling per m2												1.3838	(108)
Energy for space heating												51.7973	(99)
Energy for space cooling												1.3838	(108)
Total												53.1811	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month												
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	492.8337	571.4267	649.4370	734.3343	794.6602	786.0417	747.8580	686.3951	619.5514	539.5803	481.5249	465.0929	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9992	0.9981	0.9950	0.9826	0.9391	0.8228	0.6660	0.7312	0.9273	0.9907	0.9983	0.9994	(86)
MIT	19.5251	19.6711	19.9295	20.2938	20.6366	20.8826	20.9686	20.9511	20.7560	20.3174	19.8642	19.5102	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9989	0.9975	0.9930	0.9749	0.9094	0.7372	0.5244	0.5947	0.8785	0.9854	0.9976	0.9992	(89)
MIT 2	18.5342	18.6827	18.9429	19.3158	19.6445	19.8611	19.9115	19.9073	19.7645	19.3444	18.8888	18.5299	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9966	0.9911	0.9710	0.9064	0.7480	0.5493	0.6182	0.8798	0.9827	0.9968	0.9988	(94)
Useful gains	492.0532	569.4704	643.6664	713.0159	720.2874	587.9912	410.7625	424.2999	545.0681	530.2390	479.9888	464.5416	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1815.0152	1751.9102	1578.2048	1302.8707	995.9211	657.6752	422.6736	444.8611	709.8069	1093.6613	1476.4482	1801.9653	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	984.2838	794.5996	695.2966	424.6954	205.0714	0.0000	0.0000	0.0000	0.0000	419.1862	717.4507	995.0433	(98)
Space heating												5235.6270	(98)
Space heating per m2											(98) / (4) =	51.9511	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8640	0.8258	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	890.8440	773.0934	756.8898	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1024.8793	978.0170	908.2493	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	96.5054	152.4631	112.6114	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												361.5799	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.1264	38.1158	28.1529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												90.3950 (107)
Space cooling per m2												0.8970 (108)
Energy for space heating												51.9511 (99)
Energy for space cooling												0.8970 (108)
Total												52.8480 (109)
Target Fabric Energy Efficiency (TFEE)												60.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.4279	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	
util living area													
	0.9753	0.9661	0.9403	0.8792	0.7689	0.5858	0.4467	0.4709	0.7158	0.8958	0.9591	0.9784	(86)
MIT	19.3285	19.4926	19.8461	20.3034	20.6819	20.9094	20.9727	20.9682	20.8171	20.3748	19.8153	19.3269	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)
util rest of house													
	0.9698	0.9585	0.9264	0.8501	0.7110	0.4904	0.3261	0.3455	0.6304	0.8634	0.9483	0.9734	(89)
MIT 2	17.6702	17.9121	18.4157	19.0566	19.5509	19.8044	19.8586	19.8593	19.7272	19.1704	18.3879	17.6779	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9587	18.1870	18.6645	19.2735	19.7476	19.9966	20.0524	20.0522	19.9168	19.3799	18.6362	17.9647	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8087	18.0370	18.5145	19.1235	19.5976	19.8466	19.9024	19.9022	19.7668	19.2299	18.4862	17.8147	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9047	0.8267	0.6954	0.4886	0.3297	0.3490	0.6211	0.8400	0.9296	0.9602	(94)
Useful gains	745.0566	802.7768	856.0071	866.9067	757.0171	547.3690	350.5777	348.4834	567.2348	686.4803	706.9203	708.2525	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1673.2547	1635.7728	1483.2534	1232.2694	908.8389	580.5092	356.8016	355.8015	641.6099	999.7200	1344.1348	1636.1757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	690.5794	559.7733	466.6712	263.0611	112.9554	0.0000	0.0000	0.0000	0.0000	233.0504	458.7945	690.3749	(98)
Space heating												3475.2601	(98)
RHI space heating demand												3475	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.4279	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

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Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9801	0.9703	0.9503	0.9033	0.8133	0.6682	0.5249	0.5732	0.7803	0.9235	0.9698	0.9829	(86)
MIT	19.1318	19.3369	19.6862	20.1580	20.5677	20.8471	20.9493	20.9315	20.7260	20.2050	19.5984	19.1056	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9757	0.9637	0.9387	0.8795	0.7652	0.5822	0.4054	0.4540	0.7080	0.8997	0.9620	0.9791	(89)
MIT 2	17.3659	17.6644	18.1687	18.8453	19.3968	19.7429	19.8385	19.8292	19.6137	18.9259	18.0573	17.3370	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6730	17.9553	18.4327	19.0737	19.6005	19.9349	20.0317	20.0209	19.8071	19.1484	18.3254	17.6446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5230	17.8053	18.2827	18.9237	19.4505	19.7849	19.8817	19.8709	19.6571	18.9984	18.1754	17.4946	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9473	0.9177	0.8555	0.7456	0.5756	0.4074	0.4545	0.6930	0.8763	0.9454	0.9674	(94)
Useful gains	723.1883	794.6938	844.6558	861.0509	793.8530	601.7530	406.1753	422.7777	596.6818	684.1088	686.3121	692.2108	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1768.4540	1719.5473	1564.2289	1307.7766	1007.8804	663.9236	420.2145	443.1663	715.8471	1092.1317	1449.8420	1752.3896	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	777.6776	621.5015	535.3624	321.6426	159.2364	0.0000	0.0000	0.0000	0.0000	303.5690	549.7416	788.7730	(98)
Space heating												4057.5041	(98)
Space heating per m2											(98) / (4) =	40.2610	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4483.4300	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	777.6776	621.5015	535.3624	321.6426	159.2364	0.0000	0.0000	0.0000	0.0000	303.5690	549.7416	788.7730	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	859.3123	686.7420	591.5607	355.4061	175.9518	0.0000	0.0000	0.0000	0.0000	335.4354	607.4492	871.5724	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8909	89.8439	89.7413	89.4990	88.9944	87.3000	87.3000	87.3000	87.3000	89.4325	89.7643	89.9122	(217)
Fuel for water heating, kWh/month													
	196.1787	172.1072	178.8439	157.8081	153.3702	136.5557	128.1658	144.7599	145.8047	163.9128	176.3643	190.4264	(219)
Water heating fuel used												1944.2978	(219)
Annual totals kWh/year													
Space heating fuel - main system												4483.4300	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5655.7532	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4483.4300	3.4800	156.0234	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.2978	3.4800	67.6616	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			241.8615	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6968	(257)
SAP value		90.2794	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4483.4300	0.2160	968.4209	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.2978	0.2160	419.9683	(264)
Space and water heating			1388.3892	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			987.7344	(272)
CO2 emissions per m2			9.8000	(273)
EI value			90.9208	
EI rating			91	(274)
EI band			B	

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Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8886 = 3.916, stars = 4
Water heating environmental impact	0.216 / 0.8886 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	
util living area													
	0.9753	0.9661	0.9403	0.8792	0.7689	0.5858	0.4467	0.4709	0.7158	0.8958	0.9591	0.9784	(86)
MIT	19.3285	19.4926	19.8461	20.3034	20.6819	20.9094	20.9727	20.9682	20.8171	20.3748	19.8153	19.3269	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)
util rest of house													
	0.9698	0.9585	0.9264	0.8501	0.7110	0.4904	0.3261	0.3455	0.6304	0.8634	0.9483	0.9734	(89)
MIT 2	17.6702	17.9121	18.4157	19.0566	19.5509	19.8044	19.8586	19.8593	19.7272	19.1704	18.3879	17.6779	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9587	18.1870	18.6645	19.2735	19.7476	19.9966	20.0524	20.0522	19.9168	19.3799	18.6362	17.9647	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8087	18.0370	18.5145	19.1235	19.5976	19.8466	19.9024	19.9022	19.7668	19.2299	18.4862	17.8147	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9047	0.8267	0.6954	0.4886	0.3297	0.3490	0.6211	0.8400	0.9296	0.9602	(94)
Useful gains	745.0566	802.7768	856.0071	866.9067	757.0171	547.3690	350.5777	348.4834	567.2348	686.4803	706.9203	708.2525	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1673.2547	1635.7728	1483.2534	1232.2694	908.8389	580.5092	356.8016	355.8015	641.6099	999.7200	1344.1348	1636.1757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	690.5794	559.7733	466.6712	263.0611	112.9554	0.0000	0.0000	0.0000	0.0000	233.0504	458.7945	690.3749	(98)
Space heating												3475.2601	(98)
Space heating per m2											(98) / (4) =	34.4836	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3840.0664	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	690.5794	559.7733	466.6712	263.0611	112.9554	0.0000	0.0000	0.0000	0.0000	233.0504	458.7945	690.3749	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	763.0711	618.5340	515.6588	290.6752	124.8125	0.0000	0.0000	0.0000	0.0000	257.5142	506.9552	762.8452	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8302	89.7876	89.6590	89.3558	88.7205	87.3000	87.3000	87.3000	87.3000	89.2370	89.6569	89.8455	(217)
Fuel for water heating, kWh/month													
	196.3113	172.2150	179.0081	158.0610	153.8436	136.5557	128.1658	144.7599	145.8047	164.2719	176.5756	190.5677	(219)
Water heating fuel used												1946.1404	(219)
Annual totals kWh/year													
Space heating fuel - main system												3840.0664	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4861.9385	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3840.0664	10.2300	392.8388	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.1404	10.2300	199.0902	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			355.5377	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3840.0664	0.2160	829.4543	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.1404	0.2160	420.3663	(264)
Space and water heating			1249.8207	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			770.1254	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3840.0664	1.2200	4684.8810	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.1404	1.2200	2374.2913	(264)
Space and water heating			7059.1723	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			4221.6687	(272)
Primary energy kWh/m2/year			41.8899	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (25.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 91	A 93
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£186	£204	-£18
Mains gas	£695	£591	£104
Space heating	£523	£523	£0
Water heating	£199	£114	£85
Lighting	£158	£158	£0
Generated (PV)	-£525	-£525	£0
Total cost of fuels	£356	£270	£86
Total cost of uses	£355	£270	£85
Delivered energy	48 kWh/m²	39 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	31 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9801	0.9703	0.9503	0.9033	0.8133	0.6682	0.5249	0.5732	0.7803	0.9235	0.9698	0.9829	(86)
MIT	19.1318	19.3369	19.6862	20.1580	20.5677	20.8471	20.9493	20.9315	20.7260	20.2050	19.5984	19.1056	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9757	0.9637	0.9387	0.8795	0.7652	0.5822	0.4054	0.4540	0.7080	0.8997	0.9620	0.9791	(89)
MIT 2	17.3659	17.6644	18.1687	18.8453	19.3968	19.7429	19.8385	19.8292	19.6137	18.9259	18.0573	17.3370	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6730	17.9553	18.4327	19.0737	19.6005	19.9349	20.0317	20.0209	19.8071	19.1484	18.3254	17.6446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5230	17.8053	18.2827	18.9237	19.4505	19.7849	19.8817	19.8709	19.6571	18.9984	18.1754	17.4946	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9473	0.9177	0.8555	0.7456	0.5756	0.4074	0.4545	0.6930	0.8763	0.9454	0.9674	(94)
Useful gains	723.1883	794.6938	844.6558	861.0509	793.8530	601.7530	406.1753	422.7777	596.6818	684.1088	686.3121	692.2108	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1768.4540	1719.5473	1564.2289	1307.7766	1007.8804	663.9236	420.2145	443.1663	715.8471	1092.1317	1449.8420	1752.3896	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	777.6776	621.5015	535.3624	321.6426	159.2364	0.0000	0.0000	0.0000	0.0000	303.5690	549.7416	788.7730	(98)
Space heating												4057.5041	(98)
Space heating per m2											(98) / (4) =	40.2610	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4483.4300	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	777.6776	621.5015	535.3624	321.6426	159.2364	0.0000	0.0000	0.0000	0.0000	303.5690	549.7416	788.7730	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	859.3123	686.7420	591.5607	355.4061	175.9518	0.0000	0.0000	0.0000	0.0000	335.4354	607.4492	871.5724	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9634	89.9942	90.0304	90.0932	90.1673	87.3000	87.3000	87.3000	87.3000	89.7300	89.8762	89.9727	(217)
Fuel for water heating, kWh/month	167.9885	125.0582	98.6615	50.1511	19.7681	2.9152	0.0000	29.5406	55.5649	103.4150	142.8624	166.8427	(219)
Water heating fuel used												962.7683	(219)
Annual totals kWh/year													
Space heating fuel - main system												4483.4300	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4724.2237	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4483.4300	3.4800	156.0234	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.7683	3.4800	33.5043	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			214.2993	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6174	(257)
SAP value	91.3872	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4483.4300	0.2160	968.4209	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.7683	0.2160	207.9579	(264)
Space and water heating			1176.3788	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			801.6740	(272)
CO2 emissions per m2			7.9500	(273)
EI value			92.6311	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.7200	
Infiltration rate				0.4279	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	
util living area													
	0.9753	0.9661	0.9403	0.8792	0.7689	0.5858	0.4467	0.4709	0.7158	0.8958	0.9591	0.9784	(86)
MIT	19.3285	19.4926	19.8461	20.3034	20.6819	20.9094	20.9727	20.9682	20.8171	20.3748	19.8153	19.3269	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)
util rest of house													
	0.9698	0.9585	0.9264	0.8501	0.7110	0.4904	0.3261	0.3455	0.6304	0.8634	0.9483	0.9734	(89)
MIT 2	17.6702	17.9121	18.4157	19.0566	19.5509	19.8044	19.8586	19.8593	19.7272	19.1704	18.3879	17.6779	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9587	18.1870	18.6645	19.2735	19.7476	19.9966	20.0524	20.0522	19.9168	19.3799	18.6362	17.9647	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8087	18.0370	18.5145	19.1235	19.5976	19.8466	19.9024	19.9022	19.7668	19.2299	18.4862	17.8147	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9047	0.8267	0.6954	0.4886	0.3297	0.3490	0.6211	0.8400	0.9296	0.9602	(94)
Useful gains	745.0566	802.7768	856.0071	866.9067	757.0171	547.3690	350.5777	348.4834	567.2348	686.4803	706.9203	708.2525	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1673.2547	1635.7728	1483.2534	1232.2694	908.8389	580.5092	356.8016	355.8015	641.6099	999.7200	1344.1348	1636.1757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	690.5794	559.7733	466.6712	263.0611	112.9554	0.0000	0.0000	0.0000	0.0000	233.0504	458.7945	690.3749	(98)
Space heating												3475.2601	(98)
Space heating per m2											(98) / (4) =	34.4836	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3840.0664	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	690.5794	559.7733	466.6712	263.0611	112.9554	0.0000	0.0000	0.0000	0.0000	233.0504	458.7945	690.3749	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	763.0711	618.5340	515.6588	290.6752	124.8125	0.0000	0.0000	0.0000	0.0000	257.5142	506.9552	762.8452	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9221	89.9476	89.9750	90.0281	89.9593	87.3000	87.3000	87.3000	87.3000	89.5949	89.8023	89.9216	(217)
Fuel for water heating, kWh/month	163.2815	125.2408	98.1930	48.7545	24.6273	0.0000	0.0000	22.1819	49.8346	98.9647	137.4096	163.4112	(219)
Water heating fuel used												931.8992	(219)

Annual totals kWh/year		
Space heating fuel - main system	3840.0664	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =	-1430.4508	(233)
Total delivered energy for all uses	3897.6973	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3840.0664	10.2300	392.8388	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	931.8992	10.2300	95.3333	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			270.1408	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3840.0664	0.2160	829.4543	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.8992	0.2160	201.2902	(264)
Space and water heating			1030.7446	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

PV Unit	-1430.4508	0.5190	-742.4040 (269)
Total kg/year			576.9993 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3840.0664	1.2200	4684.8810	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.8992	1.2200	1136.9170	(264)
Space and water heating			5821.7980	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			3137.7944	(272)
Primary energy kWh/m2/year			31.1351	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		77.96 (37)
Summer heat loss coefficient		421.84 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	6.3600	119.9223	0.4600	0.0000	0.9000	315.7603
North West	5.0200	98.8453	0.4600	0.0000	0.9000	205.4281
North West	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						657.4586

	Jun	Jul	Aug	
Solar gains	700	657	574	(P4)
Internal gains	488	468	477	
Total summer gains	1189	1125	1051	(P5)
Summer gain/loss ratio	2.82	2.67	2.49	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.70	21.45	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-324	**Issued on Date**	10/08/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-As-DET
Property	17, House Sparrow Way, BOTLEY, SO32 2UR		

SAP Rating	90 B	**DER**	11.72	**TER**	19.00
Environmental	91 B	**% DER<TER**	38.31		
CO_2 Emissions (t/year)	0.81	**DFEE**	53.38	**TFEE**	60.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.16		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.72 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.89 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 6.36 m², No overhang
Windows facing North West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.8900	
Infiltration rate		0.4364	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5564	0.5455	0.5346	0.4801	0.4692	0.4146	0.4146	0.4037	0.4364	0.4692	0.4910	0.5128	(22b)
Effective ac	0.6548	0.6488	0.6429	0.6152	0.6101	0.5859	0.5859	0.5815	0.5952	0.6101	0.6205	0.6315	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.2947	55.7779	55.2713	52.8918	52.4466	50.3742	50.3742	49.9905	51.1725	52.4466	53.3473	54.2888	(38)
Heat transfer coeff	134.2537	133.7369	133.2303	130.8509	130.4057	128.3333	128.3333	127.9495	129.1316	130.4057	131.3063	132.2479	(39)
Average = Sum(39)m / 12 =												130.8488	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3321	1.3270	1.3220	1.2984	1.2940	1.2734	1.2734	1.2696	1.2813	1.2940	1.3029	1.3122	(40)
HLP (average)												1.2984	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	542.6957	633.1929	724.0748	823.7343	895.9616	887.3742	843.5044	773.9488	695.3660	601.4748	532.7547	511.6465	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3100	33.4388	33.5659	34.1763	34.2930	34.8468	34.8468	34.9513	34.6313	34.2930	34.0578	33.8153	
alpha	3.2207	3.2293	3.2377	3.2784	3.2862	3.3231	3.3231	3.3301	3.3088	3.2862	3.2705	3.2544	
util living area													
	0.9921	0.9864	0.9735	0.9400	0.8671	0.7381	0.5986	0.6551	0.8527	0.9603	0.9873	0.9935	(86)
MIT	18.8769	19.0926	19.4672	19.9835	20.4517	20.7897	20.9245	20.8968	20.6239	20.0206	19.3694	18.8543	(87)
Th 2	19.8157	19.8197	19.8236	19.8421	19.8456	19.8617	19.8617	19.8647	19.8555	19.8456	19.8386	19.8313	(88)
util rest of house													
	0.9902	0.9831	0.9668	0.9235	0.8273	0.6551	0.4707	0.5308	0.7928	0.9463	0.9837	0.9920	(89)
MIT 2	16.9945	17.3108	17.8565	18.6070	19.2541	19.6877	19.8217	19.8044	19.5008	18.6729	17.7271	16.9706	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3220	17.6208	18.1366	18.8465	19.4624	19.8794	20.0136	19.9945	19.6961	18.9073	18.0127	17.2983	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1720	17.4708	17.9866	18.6965	19.3124	19.7294	19.8636	19.8445	19.5461	18.7573	17.8627	17.1483	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9729	0.9512	0.9013	0.8044	0.6439	0.4709	0.5282	0.7722	0.9269	0.9740	0.9862	(94)
Useful gains	533.6988	616.0585	688.7737	742.4023	720.6738	571.3858	397.1877	408.8381	536.9845	557.5225	518.8819	504.5664	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1728.1097	1681.1752	1530.3686	1281.8763	992.7018	658.2747	418.8234	440.7158	703.2659	1063.7571	1413.2154	1712.3797	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	888.6417	715.7584	626.1466	388.4213	202.3889	0.0000	0.0000	0.0000	0.0000	376.6386	643.9201	898.6131	(98)
Space heating												4740.5287	(98)
Space heating per m2											(98) / (4) =	47.0384	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5238.1532	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	888.6417	715.7584	626.1466	388.4213	202.3889	0.0000	0.0000	0.0000	0.0000	376.6386	643.9201	898.6131	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	981.9245	790.8933	691.8747	429.1949	223.6341	0.0000	0.0000	0.0000	0.0000	416.1752	711.5139	992.9427	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9540	89.9145	89.8282	89.6240	89.1833	87.3000	87.3000	87.3000	87.3000	89.5801	89.8501	89.9722	(217)
Fuel for water heating, kWh/month													
	196.0411	171.9721	178.6709	157.5880	153.0453	136.5557	128.1658	144.7599	145.8047	163.6427	176.1960	190.2994	(219)
Water heating fuel used												1942.7418	(219)
Annual totals kWh/year													
Space heating fuel - main system												5238.1532	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6468.5205	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5238.1532	0.2160	1131.4411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.7418	0.2160	419.6322	(264)
Space and water heating			1551.0733	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1181.3510	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.7200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.7200	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		28.7005	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7005	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	539.1184	616.8825	693.1714	775.2908	833.4163	821.9774	781.9754	723.5233	658.1885	581.0773	525.7569	510.5522	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9988	0.9974	0.9934	0.9785	0.9289	0.8034	0.6430	0.7046	0.9121	0.9874	0.9976	0.9991	(86)
MIT	19.5673	19.7123	19.9684	20.3279	20.6622	20.8951	20.9730	20.9585	20.7798	20.3535	19.9045	19.5517	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9983	0.9965	0.9909	0.9692	0.8957	0.7148	0.5034	0.5682	0.8570	0.9805	0.9965	0.9987	(89)
MIT 2	17.9705	18.1848	18.5606	19.0909	19.5550	19.8446	19.9095	19.9041	19.7214	19.1347	18.4775	17.9570	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9947	0.9872	0.9623	0.8897	0.7248	0.5275	0.5911	0.8564	0.9752	0.9948	0.9979	(94)
Useful gains	537.6747	613.5855	684.3288	746.0702	741.4647	595.7993	412.5302	427.6983	563.6486	566.6719	523.0059	509.5018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1757.2657	1701.1671	1539.5380	1280.7310	987.4014	656.2952	422.5673	444.6968	705.9830	1073.1773	1435.3719	1744.0559	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating												4794.6907	(98)
Space heating per m2											(98) / (4) =	47.5758	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5133.5018	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	971.4943	782.4998	681.2373	412.1582	195.9068	0.0000	0.0000	0.0000	0.0000	403.4689	703.3228	983.4136	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2876	88.1330	87.7861	86.9721	85.2353	80.3000	80.3000	80.3000	80.3000	86.8241	87.8802	88.3479	(217)
Fuel for water heating, kWh/month													
	241.4382	213.1885	224.8054	201.9957	199.5525	186.5567	178.7355	199.2482	201.4487	211.3188	220.7179	235.4804	(219)
Water heating fuel used												2514.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												5133.5018	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8154.1709	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5133.5018	0.2160	1108.8364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2514.4865	0.2160	543.1291	(264)
Space and water heating			1651.9655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1914.6742	(272)
Emissions per m2 for space and water heating			16.3918	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3918 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			19.0000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.3980	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3980	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4378	0.4279	0.3781	0.3781	0.3682	0.3980	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5915	0.5715	0.5715	0.5678	0.5792	0.5915	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.0564	53.6265	53.2051	51.2258	50.8555	49.1316	49.1316	48.8124	49.7956	50.8555	51.6046	52.3879	(38)
Heat transfer coeff	132.0155	131.5856	131.1642	129.1849	128.8146	127.0907	127.0907	126.7714	127.7547	128.8146	129.5637	130.3469	(39)
Average = Sum(39)m / 12 =												129.1831	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3099	1.3057	1.3015	1.2819	1.2782	1.2611	1.2611	1.2579	1.2677	1.2782	1.2856	1.2934	(40)
HLP (average)												1.2818	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	508.7810	600.1113	692.7231	794.7373	868.4953	862.0607	820.0174	748.1180	668.6997	572.3718	500.9029	478.5613	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8748	33.9855	34.0947	34.6170	34.7166	35.1875	35.1875	35.2761	35.0046	34.7166	34.5158	34.3084	
alpha	3.2583	3.2657	3.2730	3.3078	3.3144	3.3458	3.3458	3.3517	3.3336	3.3144	3.3011	3.2872	
util living area													
	0.9935	0.9883	0.9764	0.9445	0.8738	0.7470	0.6076	0.6668	0.8623	0.9649	0.9894	0.9947	(86)
MIT	18.8709	19.0866	19.4612	19.9749	20.4455	20.7852	20.9227	20.8930	20.6140	20.0057	19.3546	18.8439	(87)
Th 2	19.8331	19.8364	19.8397	19.8551	19.8580	19.8715	19.8715	19.8740	19.8663	19.8580	19.8521	19.8460	(88)
util rest of house													
	0.9920	0.9855	0.9703	0.9291	0.8354	0.6652	0.4798	0.5431	0.8050	0.9523	0.9864	0.9935	(89)
MIT 2	17.8960	18.1130	18.4867	19.0011	19.4472	19.7491	19.8432	19.8307	19.6151	19.0403	18.3923	17.8784	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0656	18.2823	18.6563	19.1705	19.6208	19.9293	20.0310	20.0155	19.7888	19.2083	18.5597	18.0463	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0656	18.2823	18.6563	19.1705	19.6208	19.9293	20.0310	20.0155	19.7888	19.2083	18.5597	18.0463	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9802	0.9620	0.9173	0.8259	0.6700	0.4996	0.5605	0.8002	0.9426	0.9815	0.9906	(94)
Useful gains	502.9691	588.2280	666.3883	729.0153	717.2598	577.5784	409.6730	419.3551	535.0831	539.5437	491.6276	474.0685	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1817.2752	1760.9210	1594.4644	1326.7937	1020.3165	677.3069	436.0433	458.3420	726.7769	1108.8688	1484.7581	1804.8272	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	977.8437	788.0497	690.4886	430.4004	225.4742	0.0000	0.0000	0.0000	0.0000	423.5779	715.0540	990.0845	(98)
Space heating												5240.9730	(98)
Space heating per m2											(98) / (4) =	52.0041	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1194.6523	940.4709	963.4628	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7422	0.8144	0.7769	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	886.6629	765.9141	748.4841	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.7326	1062.3591	980.3929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.4902	220.5551	172.5401	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												556.5854	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	40.8726	55.1388	43.1350	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												139.1463	(107)
Space cooling per m2												1.3807	(108)
Energy for space heating												52.0041	(99)
Energy for space cooling												1.3807	(108)
Total												53.3848	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month												
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	492.8337	571.4267	649.4370	734.3343	794.6602	786.0417	747.8580	686.3951	619.5514	539.5803	481.5249	465.0929	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9992	0.9981	0.9950	0.9826	0.9391	0.8228	0.6660	0.7312	0.9273	0.9907	0.9983	0.9994	(86)
MIT	19.5251	19.6711	19.9295	20.2938	20.6366	20.8826	20.9686	20.9511	20.7560	20.3174	19.8642	19.5102	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9989	0.9975	0.9930	0.9749	0.9094	0.7372	0.5244	0.5947	0.8785	0.9854	0.9976	0.9992	(89)
MIT 2	18.5342	18.6827	18.9429	19.3158	19.6445	19.8611	19.9115	19.9073	19.7645	19.3444	18.8888	18.5299	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9966	0.9911	0.9710	0.9064	0.7480	0.5493	0.6182	0.8798	0.9827	0.9968	0.9988	(94)
Useful gains	492.0532	569.4704	643.6664	713.0159	720.2874	587.9912	410.7625	424.2999	545.0681	530.2390	479.9888	464.5416	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1815.0152	1751.9102	1578.2048	1302.8707	995.9211	657.6752	422.6736	444.8611	709.8069	1093.6613	1476.4482	1801.9653	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	984.2838	794.5996	695.2966	424.6954	205.0714	0.0000	0.0000	0.0000	0.0000	419.1862	717.4507	995.0433	(98)
Space heating												5235.6270	(98)
Space heating per m2											(98) / (4) =	51.9511	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8640	0.8258	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	890.8440	773.0934	756.8898	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1024.8793	978.0170	908.2493	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	96.5054	152.4631	112.6114	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												361.5799	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.1264	38.1158	28.1529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												90.3950 (107)
Space cooling per m2												0.8970 (108)
Energy for space heating												51.9511 (99)
Energy for space cooling												0.8970 (108)
Total												52.8480 (109)
Target Fabric Energy Efficiency (TFEE)												60.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.8900	
Infiltration rate		0.4364	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4582	0.4255	0.4364	0.4146	0.4146	0.4037	0.3928	0.3819	0.3710	0.4037	0.3819	0.4037	(22b)
Effective ac	0.6050	0.5905	0.5952	0.5859	0.5859	0.5815	0.5771	0.5729	0.5688	0.5815	0.5729	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0117	50.7683	51.1725	50.3742	50.3742	49.9905	49.6169	49.2536	48.9005	49.9905	49.2536	49.9905	(38)
Heat transfer coeff	129.9708	128.7273	129.1316	128.3333	128.3333	127.9495	127.5760	127.2127	126.8596	127.9495	127.2127	127.9495	(39)
Average = Sum(39)m / 12 =												128.1005	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2896	1.2773	1.2813	1.2734	1.2734	1.2696	1.2659	1.2623	1.2588	1.2696	1.2623	1.2696	(40)
HLP (average)												1.2711	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4077	34.7401	34.6313	34.8468	34.8468	34.9513	35.0536	35.1537	35.2516	34.9513	35.1537	34.9513	
alpha	3.2938	3.3160	3.3088	3.3231	3.3231	3.3301	3.3369	3.3436	3.3501	3.3301	3.3436	3.3301	
util living area													
	0.9753	0.9661	0.9404	0.8795	0.7695	0.5866	0.4474	0.4715	0.7163	0.8960	0.9592	0.9784	(86)
MIT	19.3229	19.4878	19.8416	20.3001	20.6799	20.9086	20.9724	20.9679	20.8160	20.3722	19.8120	19.3225	(87)
Th 2	19.8490	19.8587	19.8555	19.8617	19.8617	19.8647	19.8677	19.8705	19.8733	19.8647	19.8705	19.8647	(88)
util rest of house													
	0.9698	0.9586	0.9265	0.8504	0.7116	0.4910	0.3264	0.3459	0.6309	0.8636	0.9484	0.9734	(89)
MIT 2	17.6605	17.9037	18.4077	19.0506	19.5466	19.8018	19.8565	19.8573	19.7245	19.1654	18.3820	17.6703	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9496	18.1792	18.6571	19.2680	19.7438	19.9943	20.0506	20.0505	19.9144	19.3753	18.6308	17.9577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7996	18.0292	18.5071	19.1180	19.5938	19.8443	19.9006	19.9005	19.7644	19.2253	18.4808	17.8077	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9048	0.8270	0.6959	0.4892	0.3301	0.3494	0.6215	0.8402	0.9296	0.9602	(94)
Useful gains	745.0651	802.8054	856.1091	867.1740	757.5344	547.9973	351.0005	348.8723	567.6308	686.6487	706.9537	708.2553	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1676.5742	1638.6010	1485.9328	1234.3046	910.3662	581.4398	357.2899	356.2611	642.4634	1001.2490	1346.0077	1638.7405	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	693.0428	561.6547	468.5889	264.3340	113.7069	0.0000	0.0000	0.0000	0.0000	234.0626	460.1189	692.2810	(98)
Space heating												3487.7897	(98)
RHI space heating demand												3488	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.8900	
Infiltration rate		0.4364	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5564	0.5455	0.5346	0.4801	0.4692	0.4146	0.4146	0.4037	0.4364	0.4692	0.4910	0.5128	(22b)
Effective ac	0.6548	0.6488	0.6429	0.6152	0.6101	0.5859	0.5859	0.5815	0.5952	0.6101	0.6205	0.6315	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.2947	55.7779	55.2713	52.8918	52.4466	50.3742	50.3742	49.9905	51.1725	52.4466	53.3473	54.2888	(38)
Heat transfer coeff	134.2537	133.7369	133.2303	130.8509	130.4057	128.3333	128.3333	127.9495	129.1316	130.4057	131.3063	132.2479	(39)
Average = Sum(39)m / 12 =												130.8488	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3321	1.3270	1.3220	1.2984	1.2940	1.2734	1.2734	1.2696	1.2813	1.2940	1.3029	1.3122	(40)
HLP (average)												1.2984	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3100	33.4388	33.5659	34.1763	34.2930	34.8468	34.8468	34.9513	34.6313	34.2930	34.0578	33.8153	
alpha	3.2207	3.2293	3.2377	3.2784	3.2862	3.3231	3.3231	3.3301	3.3088	3.2862	3.2705	3.2544	
util living area													
	0.9802	0.9704	0.9504	0.9036	0.8139	0.6690	0.5257	0.5740	0.7809	0.9237	0.9699	0.9829	(86)
MIT	19.1235	19.3290	19.6793	20.1534	20.5646	20.8458	20.9488	20.9309	20.7241	20.2011	19.5928	19.0984	(87)
Th 2	19.8157	19.8197	19.8236	19.8421	19.8456	19.8617	19.8617	19.8647	19.8555	19.8456	19.8386	19.8313	(88)
util rest of house													
	0.9757	0.9638	0.9388	0.8799	0.7658	0.5828	0.4059	0.4545	0.7086	0.9000	0.9620	0.9791	(89)
MIT 2	17.3514	17.6507	18.1566	18.8369	19.3908	19.7397	19.8360	19.8268	19.6095	18.9187	18.0474	17.3246	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6596	17.9426	18.4214	19.0659	19.5949	19.9321	20.0296	20.0188	19.8034	19.1417	18.3162	17.6331	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5096	17.7926	18.2714	18.9159	19.4449	19.7821	19.8796	19.8688	19.6534	18.9917	18.1662	17.4831	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8557	0.7460	0.5761	0.4079	0.4550	0.6935	0.8765	0.9455	0.9674	(94)
Useful gains	723.1835	794.7177	844.7532	861.3018	794.3777	602.3518	406.6901	423.2553	597.1060	684.2466	686.3320	692.2028	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1773.4439	1724.2224	1568.3129	1310.5893	1009.9853	665.0368	420.8760	443.8328	717.1190	1094.3308	1453.0669	1756.6667	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	781.3938	624.6271	538.3284	323.4870	160.4120	0.0000	0.0000	0.0000	0.0000	305.1026	552.0491	791.9611	(98)
Space heating												4077.3611	(98)
Space heating per m2											(98) / (4) =	40.4580	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4505.3714	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	781.3938	624.6271	538.3284	323.4870	160.4120	0.0000	0.0000	0.0000	0.0000	305.1026	552.0491	791.9611	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	863.4185	690.1957	594.8380	357.4442	177.2508	0.0000	0.0000	0.0000	0.0000	337.1299	609.9990	875.0951	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8933	89.8465	89.7445	89.5029	89.0003	87.3000	87.3000	87.3000	87.3000	89.4361	89.7667	89.9141	(217)
Fuel for water heating, kWh/month													
	196.1736	172.1022	178.8375	157.8012	153.3601	136.5557	128.1658	144.7599	145.8047	163.9062	176.3597	190.4223	(219)
Water heating fuel used												1944.2489	(219)
Annual totals kWh/year													
Space heating fuel - main system												4505.3714	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5737.2458	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4505.3714	3.4800	156.7869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.2489	3.4800	67.6599	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			250.4846	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7217	(257)
SAP value		89.9328	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4505.3714	0.2160	973.1602	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.2489	0.2160	419.9578	(264)
Space and water heating			1393.1180	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1023.3956	(272)
CO2 emissions per m2			10.1500	(273)
EI value			90.5930	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8886 = 3.916, stars = 4
Water heating environmental impact	0.216 / 0.8886 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4364	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4582	0.4255	0.4364	0.4146	0.4146	0.4037	0.3928	0.3819	0.3710	0.4037	0.3819	0.4037	(22b)
Effective ac	0.6050	0.5905	0.5952	0.5859	0.5859	0.5815	0.5771	0.5729	0.5688	0.5815	0.5729	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0117	50.7683	51.1725	50.3742	50.3742	49.9905	49.6169	49.2536	48.9005	49.9905	49.2536	49.9905	(38)
Heat transfer coeff	129.9708	128.7273	129.1316	128.3333	128.3333	127.9495	127.5760	127.2127	126.8596	127.9495	127.2127	127.9495	(39)
Average = Sum(39)m / 12 =												128.1005	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2896	1.2773	1.2813	1.2734	1.2734	1.2696	1.2659	1.2623	1.2588	1.2696	1.2623	1.2696	(40)
HLP (average)												1.2711	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4077	34.7401	34.6313	34.8468	34.8468	34.9513	35.0536	35.1537	35.2516	34.9513	35.1537	34.9513	
alpha	3.2938	3.3160	3.3088	3.3231	3.3231	3.3301	3.3369	3.3436	3.3501	3.3301	3.3436	3.3301	
util living area													
	0.9753	0.9661	0.9404	0.8795	0.7695	0.5866	0.4474	0.4715	0.7163	0.8960	0.9592	0.9784	(86)
MIT	19.3229	19.4878	19.8416	20.3001	20.6799	20.9086	20.9724	20.9679	20.8160	20.3722	19.8120	19.3225	(87)
Th 2	19.8490	19.8587	19.8555	19.8617	19.8617	19.8647	19.8677	19.8705	19.8733	19.8647	19.8705	19.8647	(88)
util rest of house													
	0.9698	0.9586	0.9265	0.8504	0.7116	0.4910	0.3264	0.3459	0.6309	0.8636	0.9484	0.9734	(89)
MIT 2	17.6605	17.9037	18.4077	19.0506	19.5466	19.8018	19.8565	19.8573	19.7245	19.1654	18.3820	17.6703	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9496	18.1792	18.6571	19.2680	19.7438	19.9943	20.0506	20.0505	19.9144	19.3753	18.6308	17.9577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7996	18.0292	18.5071	19.1180	19.5938	19.8443	19.9006	19.9005	19.7644	19.2253	18.4808	17.8077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9048	0.8270	0.6959	0.4892	0.3301	0.3494	0.6215	0.8402	0.9296	0.9602	(94)
Useful gains	745.0651	802.8054	856.1091	867.1740	757.5344	547.9973	351.0005	348.8723	567.6308	686.6487	706.9537	708.2553	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1676.5742	1638.6010	1485.9328	1234.3046	910.3662	581.4398	357.2899	356.2611	642.4634	1001.2490	1346.0077	1638.7405	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	693.0428	561.6547	468.5889	264.3340	113.7069	0.0000	0.0000	0.0000	0.0000	234.0626	460.1189	692.2810	(98)
Space heating												3487.7897	(98)
Space heating per m2											(98) / (4) =	34.6080	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3853.9112	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	693.0428	561.6547	468.5889	264.3340	113.7069	0.0000	0.0000	0.0000	0.0000	234.0626	460.1189	692.2810	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	765.7931	620.6129	517.7778	292.0818	125.6429	0.0000	0.0000	0.0000	0.0000	258.6328	508.4187	764.9514	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8321	89.7895	89.6615	89.3593	88.7258	87.3000	87.3000	87.3000	87.3000	89.2403	89.6587	89.8470	(217)
Fuel for water heating, kWh/month													
	196.3072	172.2114	179.0030	158.0548	153.8345	136.5557	128.1658	144.7599	145.8047	164.2658	176.5721	190.5646	(219)
Water heating fuel used												1946.0997	(219)
Annual totals kWh/year													
Space heating fuel - main system												3853.9112	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4937.2164	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3853.9112	10.2300	394.2551	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.0997	10.2300	199.0860	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			379.5230	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3853.9112	0.2160	832.4448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.0997	0.2160	420.3575	(264)
Space and water heating			1252.8024	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			805.0120	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3853.9112	1.2200	4701.7717	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.0997	1.2200	2374.2416	(264)
Space and water heating			7076.0133	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4427.2340	(272)
Primary energy kWh/m2/year			43.9297	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (24.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 91	A 92
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£186	£204	-£18
Mains gas	£696	£593	£104
Space heating	£525	£525	£0
Water heating	£199	£114	£85
Lighting	£158	£158	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£379	£294	£86
Total cost of uses	£379	£294	£85
Delivered energy	49 kWh/m²	39 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	44 kWh/m²	33 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4364	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5564	0.5455	0.5346	0.4801	0.4692	0.4146	0.4146	0.4037	0.4364	0.4692	0.4910	0.5128	(22b)
Effective ac	0.6548	0.6488	0.6429	0.6152	0.6101	0.5859	0.5859	0.5815	0.5952	0.6101	0.6205	0.6315	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.2947	55.7779	55.2713	52.8918	52.4466	50.3742	50.3742	49.9905	51.1725	52.4466	53.3473	54.2888	(38)
Heat transfer coeff	134.2537	133.7369	133.2303	130.8509	130.4057	128.3333	128.3333	127.9495	129.1316	130.4057	131.3063	132.2479	(39)
Average = Sum(39)m / 12 =												130.8488	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3321	1.3270	1.3220	1.2984	1.2940	1.2734	1.2734	1.2696	1.2813	1.2940	1.3029	1.3122	(40)
HLP (average)												1.2984	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3100	33.4388	33.5659	34.1763	34.2930	34.8468	34.8468	34.9513	34.6313	34.2930	34.0578	33.8153	
alpha	3.2207	3.2293	3.2377	3.2784	3.2862	3.3231	3.3231	3.3301	3.3088	3.2862	3.2705	3.2544	
util living area													
	0.9802	0.9704	0.9504	0.9036	0.8139	0.6690	0.5257	0.5740	0.7809	0.9237	0.9699	0.9829	(86)
MIT	19.1235	19.3290	19.6793	20.1534	20.5646	20.8458	20.9488	20.9309	20.7241	20.2011	19.5928	19.0984	(87)
Th 2	19.8157	19.8197	19.8236	19.8421	19.8456	19.8617	19.8617	19.8647	19.8555	19.8456	19.8386	19.8313	(88)
util rest of house													
	0.9757	0.9638	0.9388	0.8799	0.7658	0.5828	0.4059	0.4545	0.7086	0.9000	0.9620	0.9791	(89)
MIT 2	17.3514	17.6507	18.1566	18.8369	19.3908	19.7397	19.8360	19.8268	19.6095	18.9187	18.0474	17.3246	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6596	17.9426	18.4214	19.0659	19.5949	19.9321	20.0296	20.0188	19.8034	19.1417	18.3162	17.6331	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5096	17.7926	18.2714	18.9159	19.4449	19.7821	19.8796	19.8688	19.6534	18.9917	18.1662	17.4831	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8557	0.7460	0.5761	0.4079	0.4550	0.6935	0.8765	0.9455	0.9674	(94)
Useful gains	723.1835	794.7177	844.7532	861.3018	794.3777	602.3518	406.6901	423.2553	597.1060	684.2466	686.3320	692.2028	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1773.4439	1724.2224	1568.3129	1310.5893	1009.9853	665.0368	420.8760	443.8328	717.1190	1094.3308	1453.0669	1756.6667	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	781.3938	624.6271	538.3284	323.4870	160.4120	0.0000	0.0000	0.0000	0.0000	305.1026	552.0491	791.9611	(98)
Space heating												4077.3611	(98)
Space heating per m2											(98) / (4) =	40.4580	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4505.3714	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	781.3938	624.6271	538.3284	323.4870	160.4120	0.0000	0.0000	0.0000	0.0000	305.1026	552.0491	791.9611	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	863.4185	690.1957	594.8380	357.4442	177.2508	0.0000	0.0000	0.0000	0.0000	337.1299	609.9990	875.0951	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9656	89.9964	90.0326	90.0953	90.1695	87.3000	87.3000	87.3000	87.3000	89.7329	89.8783	89.9745	(217)
Fuel for water heating, kWh/month	167.9846	125.0553	98.6591	50.1500	19.7676	2.9152	0.0000	29.5406	55.5649	103.4116	142.8591	166.8394	(219)
Water heating fuel used												962.7473	(219)
Annual totals kWh/year													
Space heating fuel - main system												4505.3714	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4805.7441	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4505.3714	3.4800	156.7869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.7473	3.4800	33.5036	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			222.9233	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6423	(257)
SAP value	91.0406	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4505.3714	0.2160	973.1602	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.7473	0.2160	207.9534	(264)
Space and water heating			1181.1136	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			837.3413	(272)
CO2 emissions per m2			8.3100	(273)
EI value			92.3032	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4364	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4364	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4582	0.4255	0.4364	0.4146	0.4146	0.4037	0.3928	0.3819	0.3710	0.4037	0.3819	0.4037	(22b)
Effective ac	0.6050	0.5905	0.5952	0.5859	0.5859	0.5815	0.5771	0.5729	0.5688	0.5815	0.5729	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0117	50.7683	51.1725	50.3742	50.3742	49.9905	49.6169	49.2536	48.9005	49.9905	49.2536	49.9905	(38)
Heat transfer coeff	129.9708	128.7273	129.1316	128.3333	128.3333	127.9495	127.5760	127.2127	126.8596	127.9495	127.2127	127.9495	(39)
Average = Sum(39)m / 12 =												128.1005	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2896	1.2773	1.2813	1.2734	1.2734	1.2696	1.2659	1.2623	1.2588	1.2696	1.2623	1.2696	(40)
HLP (average)												1.2711	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	45.1778	0.4600	0.0000	0.7700	101.7726	(77)
Northwest	5.0200	14.6176	0.4600	0.0000	0.7700	25.9914	(81)
Northwest	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(81)

Solar gains	145.0053	222.8980	341.3836	482.3963	562.0791	628.9866	592.2599	518.1964	410.5577	275.5918	175.8198	120.2655	(83)
Total gains	779.8967	852.6531	946.1831	1048.5841	1088.6018	1120.2903	1063.2506	998.4919	913.3317	817.2048	760.4688	737.5989	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4077	34.7401	34.6313	34.8468	34.8468	34.9513	35.0536	35.1537	35.2516	34.9513	35.1537	34.9513	
alpha	3.2938	3.3160	3.3088	3.3231	3.3231	3.3301	3.3369	3.3436	3.3501	3.3301	3.3436	3.3301	
util living area													
	0.9753	0.9661	0.9404	0.8795	0.7695	0.5866	0.4474	0.4715	0.7163	0.8960	0.9592	0.9784	(86)
MIT	19.3229	19.4878	19.8416	20.3001	20.6799	20.9086	20.9724	20.9679	20.8160	20.3722	19.8120	19.3225	(87)
Th 2	19.8490	19.8587	19.8555	19.8617	19.8617	19.8647	19.8677	19.8705	19.8733	19.8647	19.8705	19.8647	(88)
util rest of house													
	0.9698	0.9586	0.9265	0.8504	0.7116	0.4910	0.3264	0.3459	0.6309	0.8636	0.9484	0.9734	(89)
MIT 2	17.6605	17.9037	18.4077	19.0506	19.5466	19.8018	19.8565	19.8573	19.7245	19.1654	18.3820	17.6703	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9496	18.1792	18.6571	19.2680	19.7438	19.9943	20.0506	20.0505	19.9144	19.3753	18.6308	17.9577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7996	18.0292	18.5071	19.1180	19.5938	19.8443	19.9006	19.9005	19.7644	19.2253	18.4808	17.8077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9553	0.9415	0.9048	0.8270	0.6959	0.4892	0.3301	0.3494	0.6215	0.8402	0.9296	0.9602	(94)
Useful gains	745.0651	802.8054	856.1091	867.1740	757.5344	547.9973	351.0005	348.8723	567.6308	686.6487	706.9537	708.2553	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1676.5742	1638.6010	1485.9328	1234.3046	910.3662	581.4398	357.2899	356.2611	642.4634	1001.2490	1346.0077	1638.7405	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	693.0428	561.6547	468.5889	264.3340	113.7069	0.0000	0.0000	0.0000	0.0000	234.0626	460.1189	692.2810	(98)
Space heating												3487.7897	(98)
Space heating per m2											(98) / (4) =	34.6080	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3853.9112	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	693.0428	561.6547	468.5889	264.3340	113.7069	0.0000	0.0000	0.0000	0.0000	234.0626	460.1189	692.2810	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	765.7931	620.6129	517.7778	292.0818	125.6429	0.0000	0.0000	0.0000	0.0000	258.6328	508.4187	764.9514	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9238	89.9492	89.9768	90.0301	89.9623	87.3000	87.3000	87.3000	87.3000	89.5977	89.8039	89.9229	(217)
Fuel for water heating, kWh/month													
	163.2785	125.2387	98.1910	48.7534	24.6265	0.0000	0.0000	22.1819	49.8346	98.9616	137.4072	163.4089	(219)
Water heating fuel used												931.8823	(219)
Annual totals kWh/year													
Space heating fuel - main system												3853.9112	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3972.9990	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3853.9112	10.2300	394.2551	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	931.8823	10.2300	95.3316	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			294.1285	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3853.9112	0.2160	832.4448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.8823	0.2160	201.2866	(264)
Space and water heating			1033.7314	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			611.8910	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3853.9112	1.2200	4701.7717	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.8823	1.2200	1136.8964	(264)
Space and water heating			5838.6681	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3343.3888	(272)
Primary energy kWh/m2/year			33.1751	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	343.88	(P1)
Transmission heat loss coefficient	77.96	(37)
Summer heat loss coefficient	421.84	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	6.3600	119.9223	0.4600	0.0000	0.9000	315.7603
North West	5.0200	98.8453	0.4600	0.0000	0.9000	205.4281
North West	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						657.4586

	Jun	Jul	Aug	
Solar gains	700	657	574	(P4)
Internal gains	488	468	477	
Total summer gains	1189	1125	1051	(P5)
Summer gain/loss ratio	2.82	2.67	2.49	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.70	21.45	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-325	**Issued on Date**	27/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Darwen-As-DET
Property	31, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	88 B	**DER**	12.75	**TER**	17.01
Environmental	89 B	**% DER<TER**	25.05		
CO_2 Emissions (t/year)	1.18	**DFEE**	50.18	**TFEE**	58.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.03		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 122 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.75 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.45 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03: OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.08 m², No overhang
Windows facing East: 1.03 m², No overhang
Windows facing South East: 6.50 m², No overhang
Windows facing South West: 8.16 m², No overhang
Windows facing West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.030 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200 (1b)	x	2.5400 (2b)	=	156.0068	(1b) - (3b)
First floor	60.2300 (1c)	x	2.6300 (2c)	=	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.4500	
Infiltration rate			0.3497	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4459	0.4372	0.4284	0.3847	0.3760	0.3322	0.3322	0.3235	0.3497	0.3760	0.3934	0.4109	(22b)
Effective ac	0.5994	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5523	0.5612	0.5707	0.5774	0.5844	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0513	(36)
Total fabric heat loss	(33) + (36) =	96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	62.1924	61.7919	61.3993	59.5553	59.2103	57.6042	57.6042	57.3068	58.2229	59.2103	59.9083	60.6379	(38)
Heat transfer coeff	159.0674	158.6669	158.2743	156.4303	156.0853	154.4793	154.4793	154.1818	155.0979	156.0853	156.7833	157.5129	(39)
Average = Sum(39)m / 12 =												156.4287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3076	1.3043	1.3011	1.2859	1.2831	1.2699	1.2699	1.2674	1.2750	1.2831	1.2888	1.2948	(40)
HLP (average)												1.2859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	506.1781	503.9041	487.1911	459.9822	431.8858	405.1596	388.0137	394.5683	408.7327	436.1753	467.7391	491.8640	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	739.8579	914.9690	1082.4022	1249.4493	1361.4475	1347.3493	1288.3746	1187.8330	1071.0095	899.5016	750.0490	690.2585	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8697	31.9502	32.0294	32.4070	32.4786	32.8163	32.8163	32.8796	32.6854	32.4786	32.3340	32.1842	
alpha	3.1246	3.1300	3.1353	3.1605	3.1652	3.1878	3.1878	3.1920	3.1790	3.1652	3.1556	3.1456	
util living area													
	0.9866	0.9738	0.9476	0.8888	0.7837	0.6335	0.4927	0.5447	0.7604	0.9248	0.9771	0.9892	(86)
MIT	18.9128	19.1961	19.6225	20.1477	20.5806	20.8522	20.9509	20.9318	20.7206	20.1371	19.4253	18.8657	(87)
Th 2	19.8349	19.8375	19.8400	19.8519	19.8541	19.8645	19.8645	19.8664	19.8605	19.8541	19.8496	19.8449	(88)
util rest of house													
	0.9837	0.9682	0.9360	0.8635	0.7337	0.5492	0.3792	0.4299	0.6879	0.9021	0.9712	0.9868	(89)
MIT 2	17.0685	17.4802	18.0943	18.8396	19.4169	19.7470	19.8393	19.8283	19.6097	18.8434	17.8238	17.0060	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.3299	17.7234	18.3108	19.0250	19.5818	19.9036	19.9968	19.9847	19.7672	19.0267	18.0507	17.2696	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1799	17.5734	18.1608	18.8750	19.4318	19.7536	19.8468	19.8347	19.6172	18.8767	17.9007	17.1196	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9518	0.9128	0.8364	0.7123	0.5401	0.3773	0.4264	0.6697	0.8760	0.9559	0.9777	(94)
Useful gains	719.9534	870.8573	988.0126	1044.9970	969.7658	727.6973	486.1306	506.5137	717.2082	787.9372	716.9389	674.8771	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2048.7673	2010.8417	1845.6095	1560.3939	1206.8210	796.1297	501.5663	529.5625	855.6984	1291.8718	1693.3727	2034.9981	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

988.6375	766.0695	638.0521	371.0858	176.3690	0.0000	0.0000	0.0000	0.0000	374.9274	703.0323	1011.9300	(98)
Space heating											5030.1037	(98)
Space heating per m2										(98) / (4) =	41.3490	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)											0.0000	(201)
Fraction of space heat from main system(s)											1.0000	(202)
Efficiency of main space heating system 1 (in %)											90.4000	(206)
Efficiency of secondary/supplementary heating system, %											0.0000	(208)
Space heating requirement											5564.2740	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	988.6375	766.0695	638.0521	371.0858	176.3690	0.0000	0.0000	0.0000	0.0000	374.9274	703.0323	1011.9300	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1093.6255	847.4220	705.8098	410.4931	195.0985	0.0000	0.0000	0.0000	0.0000	414.7427	777.6906	1119.3916	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3001	88.0755	87.6295	86.6607	84.7817	79.7000	79.7000	79.7000	79.7000	86.5970	87.8565	88.3805	(217)
Fuel for water heating, kWh/month													
	241.0207	212.8261	224.2916	202.8048	202.7727	192.1655	184.0106	202.6664	202.5435	210.4764	219.9933	234.8406	(219)
Water heating fuel used												2530.4123	(219)
Annual totals kWh/year													
Space heating fuel - main system												5564.2740	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												7715.4145	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5564.2740	0.2160	1201.8832	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2530.4123	0.2160	546.5690	(264)
Space and water heating			1748.4522	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total CO2, kg/year			1551.6102	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.7500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		12.7500	ZC1
Total Floor Area	TFA	121.6500	
Assumed number of occupants	N	2.8695	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.9971	ZC2
CO2 emissions from cooking, equation (L16)		1.5443	ZC3
Total CO2 emissions		28.2915	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.2915	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3772	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3772	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.9083			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.6285	(36)
Total fabric heat loss					(33) + (36) =		90.5368	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8695	(42)
Average daily hot water use (litres/day)												102.3499	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)

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Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
								Total per year (kWh/year) = Sum(64)m =				2179.9712	(64)
Heat gains from water heating, kWh/month													
	94.2164	83.5099	88.8046	81.1343	80.6147	73.6210	72.2165	77.1604	76.3712	84.0568	86.9618	92.4648	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	126.6350	124.2707	119.3611	112.6865	108.3531	102.2514	97.0652	103.7102	106.0711	112.9795	120.7803	124.2806	(72)
Total internal gains													
	508.8838	506.6098	489.8968	462.6879	434.5915	407.8653	390.7194	397.2740	411.4384	438.8810	470.4448	494.5697	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
East	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(76)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	201.6250	354.6775	513.5637	681.1728	802.0501	812.9458	776.8549	684.4494	571.4297	399.7700	243.5844	171.1800	(83)
Total gains	710.5088	861.2873	1003.4605	1143.8607	1236.6416	1220.8112	1167.5743	1081.7235	982.8681	838.6510	714.0292	665.7496	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area													
	0.9982	0.9952	0.9865	0.9564	0.8734	0.7123	0.5456	0.6046	0.8465	0.9753	0.9960	0.9987	(86)
MIT	19.5874	19.7740	20.0651	20.4403	20.7542	20.9356	20.9856	20.9770	20.8466	20.4290	19.9393	19.5614	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house													
	0.9976	0.9936	0.9816	0.9395	0.8253	0.6161	0.4174	0.4738	0.7714	0.9627	0.9943	0.9982	(89)
MIT 2	17.9895	18.2638	18.6881	19.2313	19.6480	19.8574	19.8945	19.8927	19.7726	19.2262	18.5158	17.9595	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.2159	18.4778	18.8832	19.4027	19.8047	20.0102	20.0492	20.0464	19.9248	19.3966	18.7176	18.1865	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2159	18.4778	18.8832	19.4027	19.8047	20.0102	20.0492	20.0464	19.9248	19.3966	18.7176	18.1865	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9905	0.9754	0.9300	0.8210	0.6266	0.4355	0.4920	0.7738	0.9549	0.9915	0.9971	(94)
Useful gains	707.7263	853.0903	978.8033	1063.8448	1015.3228	764.9784	508.4214	532.2160	760.5674	800.7933	707.9845	663.8075	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2148.8278	2090.2934	1900.7337	1589.5482	1223.3759	806.5352	514.1909	542.3275	872.5345	1327.8111	1763.0538	2134.4293	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1072.1795	831.4005	685.9162	378.5064	154.7915	0.0000	0.0000	0.0000	0.0000	392.1013	759.6499	1094.1426	(98)
Space heating												5368.6879	(98)
Space heating per m2											(98) / (4) =	44.1322	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5741.9122	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1072.1795	831.4005	685.9162	378.5064	154.7915	0.0000	0.0000	0.0000	0.0000	392.1013	759.6499	1094.1426	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1146.7160	889.1984	733.6002	404.8197	165.5524	0.0000	0.0000	0.0000	0.0000	419.3596	812.4598	1170.2060	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5150	88.3002	87.8504	86.7757	84.4972	79.8000	79.8000	79.8000	79.8000	86.7732	88.0806	88.5868	(217)
Fuel for water heating, kWh/month													
	243.2784	214.8584	226.5918	205.3422	206.4335	194.9762	186.9332	205.5657	205.3412	212.9489	222.1985	237.1344	(219)
Water heating fuel used												2561.6025	(219)
Annual totals kWh/year													
Space heating fuel - main system												5741.9122	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Total delivered energy for all uses												8835.2245	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5741.9122	0.2160	1240.2530	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2561.6025	0.2160	553.3061	(264)
Space and water heating			1793.5592	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total CO2, kg/m2/year			2069.5166	(272)
Emissions per m2 for space and water heating			14.7436	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9485	(272b)
Emissions per m2 for pumps and fans			0.3200	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7436 * 1.00) + 1.9485 + 0.3200, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.4500	
Infiltration rate			0.3497	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4459	0.4372	0.4284	0.3847	0.3760	0.3322	0.3322	0.3235	0.3497	0.3760	0.3934	0.4109	(22b)
Effective ac	0.5994	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5523	0.5612	0.5707	0.5774	0.5844	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	62.1924	61.7919	61.3993	59.5553	59.2103	57.6042	57.6042	57.3068	58.2229	59.2103	59.9083	60.6379	(38)
Heat transfer coeff	159.0674	158.6669	158.2743	156.4303	156.0853	154.4793	154.4793	154.1818	155.0979	156.0853	156.7833	157.5129	(39)
Average = Sum(39)m / 12 =												156.4287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3076	1.3043	1.3011	1.2859	1.2831	1.2699	1.2699	1.2674	1.2750	1.2831	1.2888	1.2948	(40)
HLP (average)												1.2859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822	(72)
Total internal gains													
	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	660.6155	836.5798	1005.7850	1175.2410	1288.8031	1276.9070	1219.8041	1116.8642	999.1886	825.1874	672.9196	611.8658	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8697	31.9502	32.0294	32.4070	32.4786	32.8163	32.8163	32.8796	32.6854	32.4786	32.3340	32.1842	
alpha	3.1246	3.1300	3.1353	3.1605	3.1652	3.1878	3.1878	3.1920	3.1790	3.1652	3.1556	3.1456	
util living area													
	0.9903	0.9794	0.9563	0.9025	0.8030	0.6567	0.5154	0.5711	0.7861	0.9386	0.9829	0.9923	(86)
MIT	18.8306	19.1184	19.5531	20.0934	20.5457	20.8357	20.9441	20.9218	20.6890	20.0746	19.3475	18.7835	(87)
Th 2	19.8349	19.8375	19.8400	19.8519	19.8541	19.8645	19.8645	19.8664	19.8605	19.8541	19.8496	19.8449	(88)
util rest of house													
	0.9881	0.9748	0.9463	0.8795	0.7551	0.5722	0.3985	0.4537	0.7166	0.9193	0.9784	0.9906	(89)
MIT 2	17.8648	18.1517	18.5815	19.1114	19.5276	19.7742	19.8446	19.8360	19.6666	19.1064	18.3902	17.8251	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.0017	18.2887	18.7192	19.2506	19.6718	19.9246	20.0005	19.9899	19.8115	19.2436	18.5259	17.9609	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0017	18.2887	18.7192	19.2506	19.6718	19.9246	20.0005	19.9899	19.8115	19.2436	18.5259	17.9609	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9665	0.9338	0.8648	0.7464	0.5771	0.4134	0.4675	0.7131	0.9059	0.9711	0.9865	(94)
Useful gains	649.4866	808.5448	939.1765	1016.2981	961.9589	736.9360	504.2928	522.1488	712.5213	747.5631	653.4640	603.6054	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2179.4885	2124.3479	1933.9882	1619.1465	1244.2880	822.5422	525.3013	553.4995	885.8452	1349.1339	1791.3840	2167.5177	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1138.3214	884.2197	740.1399	434.0509	210.0529	0.0000	0.0000	0.0000	0.0000	447.5687	819.3024	1163.5507	(98)
Space heating												5837.2065	(98)
Space heating per m2											(98) / (4) =	47.9836	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1452.1050	1143.1465	1171.7820	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7985	0.8599	0.8289	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1159.4497	983.0372	971.3350	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1607.9234	1538.5919	1420.4395	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	322.9010	413.3327	334.1337	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1070.3675	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	80.7253	103.3332	83.5334	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												267.5919	(107)
Space cooling per m2												2.1997	(108)
Energy for space heating												47.9836	(99)
Energy for space cooling												2.1997	(108)
Total												50.1833	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3772	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3772	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.9083			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.6285	(36)
Total fabric heat loss (33) + (36) =	90.5368	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)

Water heating gains (Table 5)

	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822	(72)

Total internal gains

	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
East	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(76)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	201.6250	354.6775	513.5637	681.1728	802.0501	812.9458	776.8549	684.4494	571.4297	399.7700	243.5844	171.1800	(83)
Total gains	628.5607	780.1925	924.1376	1066.9467	1161.2915	1147.6631	1096.2980	1008.0490	908.3415	761.6312	634.1940	584.6512	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area	0.9989	0.9969	0.9903	0.9659	0.8937	0.7429	0.5765	0.6405	0.8751	0.9829	0.9976	0.9992	(86)
MIT	19.5260	19.7140	20.0085	20.3922	20.7221	20.9227	20.9818	20.9707	20.8184	20.3763	19.8798	19.5003	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house	0.9985	0.9957	0.9866	0.9521	0.8502	0.6477	0.4433	0.5059	0.8071	0.9737	0.9965	0.9990	(89)
MIT 2	18.5231	18.7130	19.0079	19.3940	19.6987	19.8641	19.8952	19.8936	19.7923	19.3860	18.8902	18.5067	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.6653	18.8549	19.1497	19.5355	19.8437	20.0141	20.0492	20.0463	19.9378	19.5264	19.0304	18.6475	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6653	18.8549	19.1497	19.5355	19.8437	20.0141	20.0492	20.0463	19.9378	19.5264	19.0304	18.6475	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9943	0.9834	0.9465	0.8481	0.6586	0.4623	0.5248	0.8103	0.9696	0.9953	0.9985	(94)
Useful gains	627.2757	775.7416	908.7876	1009.9003	984.9304	755.8607	506.7645	529.0592	736.0449	738.4746	631.2448	583.8013	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2218.2131	2148.3433	1941.6375	1609.6475	1229.2622	807.1190	514.1898	542.3142	874.4772	1347.3971	1810.5304	2204.7835	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1183.6574	922.3884	768.4403	431.8180	181.7829	0.0000	0.0000	0.0000	0.0000	453.0384	849.0857	1206.0107	(98)
Space heating												5996.2218	(98)
Space heating per m2											(98) / (4) =	49.2908	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1401.3242	1103.1701	1130.3557	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8426	0.9080	0.8778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1180.7458	1001.7100	992.2368	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1456.8591	1394.2342	1293.2529	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000   198.8016   292.0381   223.9560     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          714.7956 (104)
Cooled fraction                                                                                          fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    49.7004    73.0095    55.9890     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          178.6989 (107)
Space cooling per m2                                                                                                                     1.4690 (108)
Energy for space heating                                                                                                                49.2908 (99)
Energy for space cooling                                                                                                                 1.4690 (108)
Total                                                                                                                                   50.7597 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  58.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3497	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3672	0.3410	0.3497	0.3322	0.3322	0.3235	0.3147	0.3060	0.2973	0.3235	0.3060	0.3235	(22b)
Effective ac	0.5674	0.5581	0.5612	0.5552	0.5552	0.5523	0.5495	0.5468	0.5442	0.5523	0.5468	0.5523	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.8732	57.9096	58.2229	57.6042	57.6042	57.3068	57.0173	56.7358	56.4622	57.3068	56.7358	57.3068	(38)
Heat transfer coeff	155.7482	154.7846	155.0979	154.4793	154.4793	154.1818	153.8924	153.6108	153.3372	154.1818	153.6108	154.1818	(39)
Average = Sum(39)m / 12 =												154.2988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2803	1.2724	1.2750	1.2699	1.2699	1.2674	1.2650	1.2627	1.2605	1.2674	1.2627	1.2674	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

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Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
								Total per year (kWh/year) = Sum(64)m =				2150.3437	(64)
RHI water heating demand												2150	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
East	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(76)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	289.6281	434.4946	637.1069	855.5298	961.6917	1060.6094	1004.8835	904.1561	750.5467	529.1512	348.9317	241.6225	(83)
Total gains	1022.5596	1162.2835	1338.0478	1514.5761	1577.3400	1637.7144	1559.6761	1468.3719	1339.0618	1159.7948	1026.4406	955.0734	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5489	32.7515	32.6854	32.8163	32.8163	32.8796	32.9414	33.0018	33.0607	32.8796	33.0018	32.8796	
alpha	3.1699	3.1834	3.1790	3.1878	3.1878	3.1920	3.1961	3.2001	3.2040	3.1920	3.2001	3.1920	
util living area													
	0.9647	0.9478	0.9051	0.8180	0.6874	0.4998	0.3734	0.3940	0.6269	0.8448	0.9396	0.9698	(86)
MIT	19.3404	19.5475	19.9508	20.4119	20.7497	20.9340	20.9805	20.9774	20.8611	20.4523	19.8515	19.3134	(87)
Th 2	19.8563	19.8625	19.8605	19.8645	19.8645	19.8664	19.8683	19.8701	19.8719	19.8664	19.8701	19.8664	(88)
util rest of house													
	0.9574	0.9373	0.8860	0.7819	0.6261	0.4129	0.2700	0.2859	0.5416	0.8044	0.9251	0.9634	(89)
MIT 2	17.6982	17.9975	18.5657	19.1966	19.6240	19.8217	19.8604	19.8609	19.7629	19.2692	18.4428	17.6666	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.9310	18.2172	18.7620	19.3688	19.7835	19.9793	20.0192	20.0191	19.9186	19.4369	18.6425	17.9000	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7810	18.0672	18.6120	19.2188	19.6335	19.8293	19.8692	19.8691	19.7686	19.2869	18.4925	17.7500	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9147	0.8594	0.7579	0.6123	0.4098	0.2701	0.2858	0.5330	0.7791	0.9012	0.9461	(94)
Useful gains	959.5617	1063.1680	1149.9732	1147.8387	965.7763	671.2058	421.2349	419.6019	713.6857	903.6534	925.0500	903.5477	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2006.1856	1976.1634	1800.9955	1501.3572	1101.9824	698.3356	426.1547	425.3657	777.1975	1216.0174	1627.1168	1965.8190	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	778.6882	613.5329	484.3607	254.5333	101.3374	0.0000	0.0000	0.0000	0.0000	232.3988	505.4881	790.3299 (98)
Space heating												3760.6693 (98)
RHI space heating demand												3761 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.4500	
Infiltration rate			0.3497	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4459	0.4372	0.4284	0.3847	0.3760	0.3322	0.3322	0.3235	0.3497	0.3760	0.3934	0.4109	(22b)
Effective ac	0.5994	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5523	0.5612	0.5707	0.5774	0.5844	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	62.1924	61.7919	61.3993	59.5553	59.2103	57.6042	57.6042	57.3068	58.2229	59.2103	59.9083	60.6379	(38)
Heat transfer coeff	159.0674	158.6669	158.2743	156.4303	156.0853	154.4793	154.4793	154.1818	155.0979	156.0853	156.7833	157.5129	(39)
Average = Sum(39)m / 12 =												156.4287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3076	1.3043	1.3011	1.2859	1.2831	1.2699	1.2699	1.2674	1.2750	1.2831	1.2888	1.2948	(40)
HLP (average)												1.2859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	966.6113	1138.8538	1296.1521	1448.5134	1545.2101	1519.2947	1455.1535	1357.4805	1250.7920	1093.9698	959.8188	911.8454	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8697	31.9502	32.0294	32.4070	32.4786	32.8163	32.8163	32.8796	32.6854	32.4786	32.3340	32.1842	
alpha	3.1246	3.1300	3.1353	3.1605	3.1652	3.1878	3.1878	3.1920	3.1790	3.1652	3.1556	3.1456	
util living area													
	0.9726	0.9542	0.9199	0.8499	0.7357	0.5815	0.4442	0.4888	0.6984	0.8841	0.9565	0.9768	(86)
MIT	19.1404	19.4083	19.8033	20.2791	20.6567	20.8849	20.9635	20.9500	20.7852	20.2846	19.6269	19.0917	(87)
Th 2	19.8349	19.8375	19.8400	19.8519	19.8541	19.8645	19.8645	19.8664	19.8605	19.8541	19.8496	19.8449	(88)
util rest of house													
	0.9669	0.9449	0.9036	0.8191	0.6819	0.4987	0.3387	0.3813	0.6215	0.8532	0.9461	0.9719	(89)
MIT 2	17.3967	17.7824	18.3455	19.0114	19.5042	19.7754	19.8463	19.8394	19.6748	19.0380	18.1102	17.3326	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.6438	18.0128	18.5521	19.1911	19.6675	19.9327	20.0046	19.9968	19.8322	19.2147	18.3252	17.5819	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4938	17.8628	18.4021	19.0411	19.5175	19.7827	19.8546	19.8468	19.6822	19.0647	18.1752	17.4319	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9501	0.9232	0.8772	0.7930	0.6640	0.4922	0.3378	0.3793	0.6079	0.8262	0.9247	0.9568	(94)
Useful gains	918.3908	1051.3339	1137.0417	1148.6288	1026.0573	747.8672	491.5216	514.9013	760.3822	903.7912	887.5544	872.4855	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2098.7033	2056.7716	1883.7930	1586.3695	1220.2022	800.6120	502.7702	531.4315	865.7865	1321.2105	1736.4017	2084.1889	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating kWh

878.1525	675.6541	555.5829	315.1733	144.4438	0.0000	0.0000	0.0000	0.0000	310.5599	611.1701	901.5074 (98)

Space heating 4392.2440 (98)
Space heating per m2 (98) / (4) = 36.1056 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4858.6769 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	878.1525	675.6541	555.5829	315.1733	144.4438	0.0000	0.0000	0.0000	0.0000	310.5599	611.1701	901.5074	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	971.4076	747.4050	614.5829	348.6430	159.7829	0.0000	0.0000	0.0000	0.0000	343.5397	676.0731	997.2427	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.0929	87.8389	87.3360	86.2544	84.2533	79.7000	79.7000	79.7000	79.7000	86.1238	87.5752	88.1844	(217)
Fuel for water heating, kWh/month													
	241.5877	213.3994	225.0453	203.7602	204.0445	192.1655	184.0106	202.6664	202.5435	211.6329	220.7002	235.3630	(219)
Water heating fuel used												2536.9190	(219)
Annual totals kWh/year													
Space heating fuel - main system												4858.6769	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												7016.3242	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4858.6769	3.4800	169.0820	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2536.9190	3.4800	88.2848	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			327.3408	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.8250 (257)
SAP value 88.4915
SAP rating (Section 12) 88 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4858.6769	0.2160	1049.4742	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2536.9190	0.2160	547.9745	(264)
Space and water heating			1597.4487	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			1400.6067	(272)
CO2 emissions per m2			11.5100	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	88.7380
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8454 = 4.116, stars = 4
Water heating environmental impact	0.216 / 0.8454 = 0.2555, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3497	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3672	0.3410	0.3497	0.3322	0.3322	0.3235	0.3147	0.3060	0.2973	0.3235	0.3060	0.3235	(22b)
Effective ac	0.5674	0.5581	0.5612	0.5552	0.5552	0.5523	0.5495	0.5468	0.5442	0.5523	0.5468	0.5523	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.8732	57.9096	58.2229	57.6042	57.6042	57.3068	57.0173	56.7358	56.4622	57.3068	56.7358	57.3068	(38)
Heat transfer coeff	155.7482	154.7846	155.0979	154.4793	154.4793	154.1818	153.8924	153.6108	153.3372	154.1818	153.6108	154.1818	(39)
Average = Sum(39)m / 12 =												154.2988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2803	1.2724	1.2750	1.2699	1.2699	1.2674	1.2650	1.2627	1.2605	1.2674	1.2627	1.2674	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
East	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(76)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	289.6281	434.4946	637.1069	855.5298	961.6917	1060.6094	1004.8835	904.1561	750.5467	529.1512	348.9317	241.6225	(83)
Total gains	1022.5596	1162.2835	1338.0478	1514.5761	1577.3400	1637.7144	1559.6761	1468.3719	1339.0618	1159.7948	1026.4406	955.0734	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5489	32.7515	32.6854	32.8163	32.8163	32.8796	32.9414	33.0018	33.0607	32.8796	33.0018	32.8796	
alpha	3.1699	3.1834	3.1790	3.1878	3.1878	3.1920	3.1961	3.2001	3.2040	3.1920	3.2001	3.1920	
util living area													
	0.9647	0.9478	0.9051	0.8180	0.6874	0.4998	0.3734	0.3940	0.6269	0.8448	0.9396	0.9698	(86)
MIT	19.3404	19.5475	19.9508	20.4119	20.7497	20.9340	20.9805	20.9774	20.8611	20.4523	19.8515	19.3134	(87)
Th 2	19.8563	19.8625	19.8605	19.8645	19.8645	19.8664	19.8683	19.8701	19.8719	19.8664	19.8701	19.8664	(88)
util rest of house													
	0.9574	0.9373	0.8860	0.7819	0.6261	0.4129	0.2700	0.2859	0.5416	0.8044	0.9251	0.9634	(89)
MIT 2	17.6982	17.9975	18.5657	19.1966	19.6240	19.8217	19.8604	19.8609	19.7629	19.2692	18.4428	17.6666	(90)
Living area fraction										fLA = Living area / (4) =		0.1417	(91)
MIT	17.9310	18.2172	18.7620	19.3688	19.7835	19.9793	20.0192	20.0191	19.9186	19.4369	18.6425	17.9000	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7810	18.0672	18.6120	19.2188	19.6335	19.8293	19.8692	19.8691	19.7686	19.2869	18.4925	17.7500	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9147	0.8594	0.7579	0.6123	0.4098	0.2701	0.2858	0.5330	0.7791	0.9012	0.9461	(94)
Useful gains	959.5617	1063.1680	1149.9732	1147.8387	965.7763	671.2058	421.2349	419.6019	713.6857	903.6534	925.0500	903.5477	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2006.1856	1976.1634	1800.9955	1501.3572	1101.9824	698.3356	426.1547	425.3657	777.1975	1216.0174	1627.1168	1965.8190	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating kWh

778.6882	613.5329	484.3607	254.5333	101.3374	0.0000	0.0000	0.0000	0.0000	232.3988	505.4881	790.3299	(98)

Space heating 3760.6693 (98)
Space heating per m2 (98) / (4) = 30.9138 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4160.0324 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	778.6882	613.5329	484.3607	254.5333	101.3374	0.0000	0.0000	0.0000	0.0000	232.3988	505.4881	790.3299	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	861.3808	678.6869	535.7972	281.5634	112.0989	0.0000	0.0000	0.0000	0.0000	257.0783	559.1682	874.2587	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.8679	87.6463	87.0275	85.7005	83.3591	79.7000	79.7000	79.7000	79.7000	85.3626	87.1632	87.9443	(217)
Fuel for water heating, kWh/month													
	242.2062	213.8683	225.8431	205.0771	206.2331	192.1655	184.0106	202.6664	202.5435	213.5199	221.7432	236.0056	(219)
Water heating fuel used												2545.8825	(219)
Annual totals kWh/year													
Space heating fuel - main system												4160.0324	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =										-1050.7868		-1050.7868	(233)
Total delivered energy for all uses												6186.8379	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4160.0324	10.2300	425.5713	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2545.8825	10.2300	260.4438	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	456.7098	36.7200	167.7039	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	36.7200	-385.8489	(252)
Total energy cost			598.4100	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4160.0324	0.2160	898.5670	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8825	0.2160	549.9106	(264)
Space and water heating			1448.4776	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	0.5190	-545.3584	(269)
Total kg/year			1179.0767	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4160.0324	1.2200	5075.2395	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8825	1.2200	3105.9767	(264)
Space and water heating			8181.2162	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	456.7098	3.0700	1402.0992 (268)
Energy saving/generation technologies			
PV Unit	-1050.7868	3.0700	-3225.9156 (269)
Primary energy kWh/year			6587.6498 (272)
Primary energy kWh/m2/year			54.1525 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 89

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 120	-266 kg (22.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£120	2.18 kg/m²	B 90	B 91
Total Savings	£120	2.18 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£195	£214	-£18
Mains gas	£789	£651	£138
Space heating	£556	£559	-£3
Water heating	£260	£138	£123
Lighting	£168	£168	£0
Generated (PV)	-£386	-£386	£0
Total cost of fuels	£598	£479	£120
Total cost of uses	£598	£479	£120
Delivered energy	51 kWh/m²	40 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.9 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	54 kWh/m²	42 kWh/m²	12 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.4500	
Infiltration rate			0.3497	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4459	0.4372	0.4284	0.3847	0.3760	0.3322	0.3322	0.3235	0.3497	0.3760	0.3934	0.4109	(22b)
Effective ac	0.5994	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5523	0.5612	0.5707	0.5774	0.5844	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0513	(36)
Total fabric heat loss					(33) + (36) =		96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	62.1924	61.7919	61.3993	59.5553	59.2103	57.6042	57.6042	57.3068	58.2229	59.2103	59.9083	60.6379	(38)
Heat transfer coeff	159.0674	158.6669	158.2743	156.4303	156.0853	154.4793	154.4793	154.1818	155.0979	156.0853	156.7833	157.5129	(39)
Average = Sum(39)m / 12 =												156.4287	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3076	1.3043	1.3011	1.2859	1.2831	1.2699	1.2699	1.2674	1.2750	1.2831	1.2888	1.2948	(40)
HLP (average)												1.2859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1262	(H8)
Utilisation factor												0.5885	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												102.3499	(H14)
Volume ratio Veff/V												1.0699	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-938.4673	(H17)
Solar input	-27.2137	-45.4118	-77.3415	-103.6529	-128.0544	-125.8979	-124.2341	-108.5439	-85.0117	-58.0530	-32.2793	-22.7732	(63)
										Solar input (sum of months) = Sum(63)m =		-938.4673	(63)
Output from w/h													
	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123	(64)
										Total per year (kWh/year) = Sum(64)m =		1053.7664	(64)
Heat gains from water heating, kWh/month													
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	958.1513	1130.3938	1286.1912	1432.5494	1522.9927	1496.8272	1432.6860	1336.0135	1236.3287	1084.0089	951.3587	903.3854	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8697	31.9502	32.0294	32.4070	32.4786	32.8163	32.8163	32.8796	32.6854	32.4786	32.3340	32.1842	
alpha	3.1246	3.1300	3.1353	3.1605	3.1652	3.1878	3.1878	3.1920	3.1790	3.1652	3.1556	3.1456	
util living area													
	0.9732	0.9550	0.9213	0.8531	0.7414	0.5880	0.4502	0.4954	0.7033	0.8863	0.9574	0.9773	(86)
MIT	19.1322	19.4005	19.7953	20.2693	20.6484	20.8812	20.9620	20.9481	20.7807	20.2777	19.6191	19.0833	(87)
Th 2	19.8349	19.8375	19.8400	19.8519	19.8541	19.8645	19.8645	19.8664	19.8605	19.8541	19.8496	19.8449	(88)
util rest of house													
	0.9676	0.9459	0.9052	0.8227	0.6879	0.5048	0.3437	0.3869	0.6266	0.8558	0.9473	0.9726	(89)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.3848	17.7715	18.3345	18.9988	19.4948	19.7722	19.8455	19.8382	19.6704	19.0289	18.0992	17.3204 (90)
Living area fraction										fLA = Living area / (4) =		0.1417 (91)
MIT	17.6324	18.0023	18.5415	19.1788	19.6583	19.9294	20.0037	19.9955	19.8277	19.2059	18.3146	17.5703 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.4824	17.8523	18.3915	19.0288	19.5083	19.7794	19.8537	19.8455	19.6777	19.0559	18.1646	17.4203 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9243	0.8790	0.7964	0.6697	0.4981	0.3427	0.3847	0.6126	0.8287	0.9261	0.9577	(94)
Useful gains	911.2725	1044.8344	1130.5008	1140.9363	1019.9051	745.5800	490.9144	514.0221	757.3905	898.3570	881.0266	865.2086	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2096.8984	2055.1095	1882.1175	1584.4556	1218.7556	800.1077	502.6349	531.2363	865.0969	1319.8422	1734.7460	2082.3633	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	882.1057	678.9049	559.2029	319.3339	147.9448	0.0000	0.0000	0.0000	0.0000	313.5850	614.6779	905.5632	(98)
Space heating												4421.3183	(98)
Space heating per m2											(98) / (4) =	36.3446	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4890.8388	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	882.1057	678.9049	559.2029	319.3339	147.9448	0.0000	0.0000	0.0000	0.0000	313.5850	614.6779	905.5632	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	975.7807	751.0010	618.5873	353.2455	163.6557	0.0000	0.0000	0.0000	0.0000	346.8860	679.9535	1001.7291	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4095	88.4316	88.4490	88.5792	88.7844	79.7000	79.7000	79.7000	79.7000	87.2577	88.0396	88.4591	(217)
Fuel for water heating, kWh/month	201.0418	152.5804	124.2981	65.1750	26.1280	8.8297	1.9166	41.4265	79.5465	131.7359	174.2229	199.9934	(219)
Water heating fuel used												1206.8949	(219)
Annual totals kWh/year													
Space heating fuel - main system												4890.8388	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 769 * 1.00) =										-910.9816		-910.9816	(233)
Total delivered energy for all uses												5768.4620	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4890.8388	3.4800	170.2012	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1206.8949	3.4800	41.9999	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-910.9816	13.1900	-120.1585	(252)
Total energy cost			288.7702	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.7278	(257)
SAP value	89.8476	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)			90 (258)
SAP band			B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4890.8388	0.2160	1056.4212	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1206.8949	0.2160	260.6893	(264)
Space and water heating			1317.1105	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-910.9816	0.5190	-472.7994	(269)
Total kg/year			1146.2185	(272)
CO2 emissions per m2			9.4200	(273)
EI value			90.7835	
EI rating			91	(274)
EI band			B	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3497	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3497	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3672	0.3410	0.3497	0.3322	0.3322	0.3235	0.3147	0.3060	0.2973	0.3235	0.3060	0.3235	(22b)
Effective ac	0.5674	0.5581	0.5612	0.5552	0.5552	0.5523	0.5495	0.5468	0.5442	0.5523	0.5468	0.5523	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.8732	57.9096	58.2229	57.6042	57.6042	57.3068	57.0173	56.7358	56.4622	57.3068	56.7358	57.3068	(38)
Heat transfer coeff	155.7482	154.7846	155.0979	154.4793	154.4793	154.1818	153.8924	153.6108	153.3372	154.1818	153.6108	154.1818	(39)
Average = Sum(39)m / 12 =												154.2988	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2803	1.2724	1.2750	1.2699	1.2699	1.2674	1.2650	1.2627	1.2605	1.2674	1.2627	1.2674	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920 (45)
Energy content (annual)										Total = Sum(45)m =		1610.3627 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538 (46)
Water storage loss:												
Store volume												190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7851 (55)
Total storage loss												
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384 (56)
If cylinder contains dedicated solar storage												
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2604 (H8)
Utilisation factor												0.5477 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												109.5000 (H13)
Daily hot water demand												102.3499 (H14)
Volume ratio Veff/V												1.0699 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-977.4719 (H17)
Solar input	-31.8875	-45.3420	-77.9320	-105.1483	-123.5030	-131.9207	-129.1464	-115.5899	-90.4989	-62.5679	-37.7145	-26.2208 (63)
										Solar input (sum of months) = Sum(63)m =		-977.4719 (63)
Output from w/h												
	173.0662	134.9992	109.3499	56.2361	27.7489	1.0144	0.0000	25.9709	57.9113	110.4348	147.9500	173.4648 (64)
										Total per year (kWh/year) = Sum(64)m =		1018.1465 (64)
Heat gains from water heating, kWh/month												
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
East	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(76)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	289.6281	434.4946	637.1069	855.5298	961.6917	1060.6094	1004.8835	904.1561	750.5467	529.1512	348.9317	241.6225 (83)
Total gains	1014.0995	1153.8234	1328.0870	1498.6121	1555.1227	1615.2469	1537.2086	1446.9049	1324.5985	1149.8339	1017.9806	946.6134 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5489	32.7515	32.6854	32.8163	32.8163	32.8796	32.9414	33.0018	33.0607	32.8796	33.0018	32.8796	
alpha	3.1699	3.1834	3.1790	3.1878	3.1878	3.1920	3.1961	3.2001	3.2040	3.1920	3.2001	3.1920	
util living area													
	0.9654	0.9487	0.9067	0.8215	0.6934	0.5055	0.3784	0.3992	0.6316	0.8474	0.9408	0.9705	(86)
MIT	19.3323	19.5399	19.9432	20.4033	20.7431	20.9318	20.9798	20.9765	20.8580	20.4463	19.8442	19.3052	(87)
Th 2	19.8563	19.8625	19.8605	19.8645	19.8645	19.8664	19.8683	19.8701	19.8719	19.8664	19.8701	19.8664	(88)
util rest of house													
	0.9582	0.9384	0.8878	0.7858	0.6322	0.4180	0.2738	0.2899	0.5462	0.8073	0.9266	0.9642	(89)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.6867	17.9868	18.5554	19.1858	19.6170	19.8200	19.8601	19.8605	19.7602	19.2618	18.4326	17.6548 (90)
Living area fraction										fLA = Living area / (4) =		0.1417 (91)
MIT	17.9199	18.2069	18.7521	19.3584	19.7766	19.9776	20.0188	20.0187	19.9158	19.4297	18.6326	17.8887 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7699	18.0569	18.6021	19.2084	19.6266	19.8276	19.8688	19.8687	19.7658	19.2797	18.4826	17.7387 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9160	0.8613	0.7615	0.6180	0.4148	0.2739	0.2898	0.5374	0.7820	0.9028	0.9471	(94)
Useful gains	952.7307	1056.8701	1143.8550	1141.1853	961.0799	670.0040	420.9707	419.2911	711.7780	899.1356	919.0416	896.5424	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2004.4693	1974.5780	1799.4549	1499.7407	1100.9105	698.0747	426.0943	425.2948	776.7723	1214.9076	1625.6088	1964.0769	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	782.4936	616.6997	487.7663	258.1599	104.0339	0.0000	0.0000	0.0000	0.0000	234.9343	508.7285	794.2457	(98)
Space heating												3787.0619	(98)
Space heating per m2											(98) / (4) =	31.1308	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4189.2278	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	782.4936	616.6997	487.7663	258.1599	104.0339	0.0000	0.0000	0.0000	0.0000	234.9343	508.7285	794.2457	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	865.5902	682.1900	539.5645	285.5751	115.0818	0.0000	0.0000	0.0000	0.0000	259.8831	562.7527	878.5904	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	173.0662	134.9992	109.3499	56.2361	27.7489	1.0144	0.0000	25.9709	57.9113	110.4348	147.9500	173.4648	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2541	88.2717	88.2308	88.2800	87.9147	79.7000	79.7000	79.7000	79.7000	86.6790	87.7459	88.2756	(217)
Fuel for water heating, kWh/month	196.1000	152.9360	123.9363	63.7020	31.5635	1.2728	0.0000	32.5858	72.6616	127.4066	168.6118	196.5036	(219)
Water heating fuel used												1167.2799	(219)
Annual totals kWh/year													
Space heating fuel - main system												4189.2278	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 887 * 1.00) =										-1050.7868		-1050.7868	(233)
Total delivered energy for all uses												4887.4307	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4189.2278	10.2300	428.5580	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1167.2799	10.2300	119.4127	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	456.7098	36.7200	167.7039	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1050.7868	36.7200	-385.8489	(252)
Total energy cost			478.7257	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4189.2278	0.2160	904.8732	(261)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1167.2799	0.2160	252.1325	(264)
Space and water heating			1157.0057	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	0.5190	-545.3584	(269)
Total kg/year			913.5547	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4189.2278	1.2200	5110.8579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1167.2799	1.2200	1424.0815	(264)
Space and water heating			6534.9394	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	456.7098	3.0700	1402.0992	(268)
Energy saving/generation technologies				
PV Unit	-1050.7868	3.0700	-3225.9156	(269)
Primary energy kWh/year			5094.8730	(272)
Primary energy kWh/m2/year			41.8814	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	150.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		415.02 (P1)
Transmission heat loss coefficient		96.88 (37)
Summer heat loss coefficient		511.90 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.0800	106.0502	0.4600	0.0000	0.9000	310.8459
East	1.0300	125.2818	0.4600	0.0000	0.9000	53.4227
South East	6.5000	127.3119	0.4600	0.0000	0.9000	342.5962
South West	1.5000	127.3119	0.4600	0.0000	0.9000	79.0607
West	1.0300	125.2818	0.4600	0.0000	0.9000	53.4227
South West	6.6600	127.3119	0.4600	0.0000	0.9000	351.0293
total:						1190.3774

	Jun	Jul	Aug	
Solar gains	1277	1190	1067	(P4)
Internal gains	574	552	561	
Total summer gains	1851	1742	1629	(P5)
Summer gain/loss ratio	3.62	3.40	3.18	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 150.0)	0.95	0.95	0.95	
Threshold temperature	19.97	21.65	21.43	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-326	**Issued on Date**	27/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Alston-Opp-DET
Property	30, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.49	**TER**	16.26
Environmental	89 B	**% DER<TER**	29.32		
CO_2 Emissions (t/year)	1.30	**DFEE**	50.17	**TFEE**	59.49
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.66		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 151 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.26 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.49 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.45 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.54 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 15.40 m², No overhang
Windows facing South East: 2.07 m², No overhang
Windows facing South West: 14.64 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.032 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3508	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4473	0.4385	0.4297	0.3859	0.3771	0.3333	0.3333	0.3245	0.3508	0.3771	0.3947	0.4122	(22b)
Effective ac	0.6000	0.5961	0.5923	0.5745	0.5711	0.5555	0.5555	0.5526	0.5615	0.5711	0.5779	0.5850	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.1660	76.6665	76.1769	73.8771	73.4469	71.4439	71.4439	71.0729	72.2154	73.4469	74.3173	75.2273	(38)
Heat transfer coeff	195.0683	194.5688	194.0792	191.7795	191.3492	189.3462	189.3462	188.9753	190.1177	191.3492	192.2196	193.1296	(39)
Average = Sum(39)m / 12 =												191.7774	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2936	1.2902	1.2870	1.2717	1.2689	1.2556	1.2556	1.2532	1.2607	1.2689	1.2747	1.2807	(40)
HLP (average)												1.2717	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use													
	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.4405	(64)
Heat gains from water heating, kWh/month													
	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009	(72)
Total internal gains													
	548.6193	546.3444	528.1942	498.4888	467.5409	438.2917	419.6432	426.2643	441.8268	471.7696	506.2379	532.8460	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.4600	0.0000	0.7700	61.5448	(75)
Southeast	2.0700	36.7938	0.4600	0.0000	0.7700	26.9770	(77)
Southwest	5.1500	36.7938	0.4600	0.0000	0.7700	67.1167	(79)
Southwest	9.4900	36.7938	0.4600	0.0000	0.7700	123.6772	(79)

Solar gains	279.3158	496.2209	733.2506	999.5472	1202.6498	1230.4941	1171.1208	1014.0107	824.5900	563.0703	338.2788	236.6272	(83)
Total gains	827.9351	1042.5653	1261.4448	1498.0361	1670.1907	1668.7858	1590.7641	1440.2750	1266.4168	1034.8399	844.5167	769.4732	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.2254	30.3030	30.3794	30.7437	30.8128	31.1388	31.1388	31.1999	31.0124	30.8128	30.6733	30.5288	
alpha	3.0150	3.0202	3.0253	3.0496	3.0542	3.0759	3.0759	3.0800	3.0675	3.0542	3.0449	3.0353	
util living area													
	0.9880	0.9757	0.9493	0.8876	0.7767	0.6242	0.4870	0.5457	0.7673	0.9299	0.9793	0.9903	(86)
MIT	18.7679	19.0629	19.5183	20.0881	20.5558	20.8427	20.9460	20.9229	20.6860	20.0535	19.3035	18.7208	(87)
Th 2	19.8459	19.8485	19.8510	19.8630	19.8653	19.8758	19.8758	19.8777	19.8717	19.8653	19.8607	19.8560	(88)
util rest of house													
	0.9854	0.9706	0.9385	0.8630	0.7277	0.5421	0.3765	0.4332	0.6977	0.9094	0.9741	0.9882	(89)
MIT 2	16.8755	17.3047	17.9618	18.7717	19.3971	19.7480	19.8469	19.8327	19.5828	18.7432	17.6651	16.8127	(90)
Living area fraction										fLA = Living area / (4) =		0.1131	(91)
MIT	17.0894	17.5035	18.1378	18.9205	19.5281	19.8718	19.9711	19.9559	19.7076	18.8913	17.8504	17.0284	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9394	17.3535	17.9878	18.7705	19.3781	19.7218	19.8211	19.8059	19.5576	18.7413	17.7004	16.8784	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9749	0.9538	0.9138	0.8331	0.7031	0.5297	0.3708	0.4254	0.6747	0.8811	0.9588	0.9794	(94)
Useful gains	807.1914	994.4280	1152.6729	1247.9877	1174.3783	883.8813	589.7991	612.6929	854.4203	911.8030	809.6865	753.6039	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2465.5525	2423.0563	2229.5431	1892.9684	1469.1995	969.7876	609.9111	643.6399	1037.5819	1557.8328	2037.5972	2448.5837	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

1233.8207	960.0382	801.1914	464.3861	219.3470	0.0000	0.0000	0.0000	0.0000	480.6461	884.0958	1261.0649	(98)

Space heating 6304.5902 (98)
Space heating per m2 (98) / (4) = 41.8076 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 6958.7088 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1233.8207	960.0382	801.1914	464.3861	219.3470	0.0000	0.0000	0.0000	0.0000	480.6461	884.0958	1261.0649	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1361.8330	1059.6448	884.3172	512.5674	242.1048	0.0000	0.0000	0.0000	0.0000	530.5145	975.8231	1391.9039	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8103	88.6174	88.2208	87.3225	85.4871	79.9000	79.9000	79.9000	79.9000	87.3181	88.4275	88.8787	(217)
Fuel for water heating, kWh/month													
	246.0950	217.2885	229.0077	207.0954	207.0769	197.6205	189.4615	208.3555	208.1309	214.7718	224.6309	239.8875	(219)
Water heating fuel used												2589.4222	(219)
Annual totals kWh/year													
Space heating fuel - main system												6958.7088	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												8911.5146	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6958.7088	0.2160	1503.0811	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2589.4222	0.2160	559.3152	(264)
Space and water heating			2062.3963	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1731.9924	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4900	ZC1
Total Floor Area	TFA	150.8000	
Assumed number of occupants	N	2.9354	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6293	ZC2
CO2 emissions from cooking, equation (L16)		1.2563	ZC3
Total CO2 emissions		25.3756	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.3756	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1026	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3526	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3526	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4496	0.4408	0.4320	0.3879	0.3791	0.3350	0.3350	0.3262	0.3526	0.3791	0.3967	0.4144	(22b)
Effective ac	0.6011	0.5972	0.5933	0.5752	0.5719	0.5561	0.5561	0.5532	0.5622	0.5719	0.5787	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			32.1100	1.3258	42.5701			(27)
GF B&B J150 P/A=0.50			76.5900	0.1300	9.9567			(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.1800	24.6510			(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.1800	4.1526			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	2.3500		2.3500	0.1300	0.3055			(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9692			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.1491	(36)
Total fabric heat loss					(33) + (36) =		112.1183	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3013	76.7965	76.3018	73.9778	73.5430	71.5190	71.5190	71.1441	72.2986	73.5430	74.4226	75.3422	(38)
Heat transfer coeff	189.4196	188.9148	188.4201	186.0961	185.6613	183.6373	183.6373	183.2624	184.4169	185.6613	186.5409	187.4605	(39)
Average = Sum(39)m / 12 =												186.0940	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2561	1.2528	1.2495	1.2341	1.2312	1.2178	1.2178	1.2153	1.2229	1.2312	1.2370	1.2431	(40)
HLP (average)												1.2340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9354	(42)
Average daily hot water use (litres/day)												103.9165	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(64)
Total per year (kWh/year) = Sum(64)m =												2244.2849	(64)
Heat gains from water heating, kWh/month													
	97.7612	86.6873	92.2666	84.4110	83.9513	76.7828	75.4246	80.4441	79.5750	87.4461	90.3277	95.9827	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	131.3995	128.9990	124.0142	117.2375	112.8378	106.6427	101.3771	108.1238	110.5209	117.5350	125.4552	129.0091	(72)
Total internal gains													
	551.5274	549.2525	531.1024	501.3970	470.4491	441.1998	422.5514	429.1725	444.7350	474.6777	509.1461	535.7542	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.6300	0.7000	0.7700	53.1025	(75)
Southeast	2.0700	36.7938	0.6300	0.7000	0.7700	23.2765	(77)
Southwest	14.6400	36.7938	0.6300	0.7000	0.7700	164.6220	(79)

Solar gains	241.0010	428.1523	632.6677	862.4354	1037.6776	1061.7024	1010.4736	874.9149	711.4778	485.8318	291.8758	204.1681	(83)
Total gains	792.5284	977.4049	1163.7701	1363.8324	1508.1267	1502.9023	1433.0250	1304.0874	1156.2127	960.5095	801.0219	739.9223	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2858	55.4336	55.5791	56.2732	56.4050	57.0267	57.0267	57.1433	56.7856	56.4050	56.1390	55.8636	
alpha	4.6857	4.6956	4.7053	4.7515	4.7603	4.8018	4.8018	4.8096	4.7857	4.7603	4.7426	4.7242	
util living area													
	0.9989	0.9967	0.9896	0.9614	0.8772	0.7131	0.5476	0.6160	0.8643	0.9816	0.9974	0.9992	(86)
MIT	19.5510	19.7361	20.0332	20.4231	20.7523	20.9363	20.9856	20.9756	20.8321	20.3936	19.9001	19.5241	(87)
Th 2	19.8754	19.8780	19.8806	19.8928	19.8951	19.9058	19.9058	19.9078	19.9017	19.8951	19.8905	19.8857	(88)
util rest of house													
	0.9985	0.9955	0.9857	0.9462	0.8300	0.6173	0.4197	0.4845	0.7936	0.9718	0.9962	0.9989	(89)
MIT 2	17.9434	18.2157	18.6495	19.2143	19.6527	19.8639	19.9007	19.8979	19.7645	19.1829	18.4646	17.9112	(90)
Living area fraction										fLA = Living area / (4) =		0.1131	(91)
MIT	18.1251	18.3876	18.8060	19.3510	19.7770	19.9851	20.0234	20.0197	19.8852	19.3198	18.6269	18.0935	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1251	18.3876	18.8060	19.3510	19.7770	19.9851	20.0234	20.0197	19.8852	19.3198	18.6269	18.0935	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9974	0.9931	0.9802	0.9364	0.8240	0.6249	0.4339	0.4988	0.7923	0.9644	0.9942	0.9981	(94)
Useful gains	790.4834	970.6775	1140.6962	1277.1120	1242.7638	939.2038	621.8481	650.4774	916.0880	926.2723	796.3563	738.5343	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2618.7525	2548.0077	2318.6928	1944.8929	1499.5888	988.9138	628.6559	663.3559	1066.8974	1618.9316	2150.2477	2604.4905	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1360.2322	1059.9659	876.4295	480.8023	191.0778	0.0000	0.0000	0.0000	0.0000	515.3385	974.8018	1388.2714	(98)
Space heating												6846.9194	(98)
Space heating per m2											(98) / (4) =	45.4040	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7322.9084	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1360.2322	1059.9659	876.4295	480.8023	191.0778	0.0000	0.0000	0.0000	0.0000	515.3385	974.8018	1388.2714	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1454.7938	1133.6534	937.3577	514.2270	204.3613	0.0000	0.0000	0.0000	0.0000	551.1642	1042.5688	1484.7823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8335	88.6530	88.2590	87.2683	84.9773	79.8000	79.8000	79.8000	79.8000	87.3424	88.4700	88.8957	(217)
Fuel for water heating, kWh/month													
	249.0751	219.9569	231.9730	210.2232	211.5020	201.1480	193.0882	212.0058	211.6716	217.8086	227.4814	242.8840	(219)
Water heating fuel used												2628.8179	(219)
Annual totals kWh/year													
Space heating fuel - main system												7322.9084	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Total delivered energy for all uses												10533.6669	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7322.9084	0.2160	1581.7482	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2628.8179	0.2160	567.8247	(264)
Space and water heating			2149.5729	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Total CO2, kg/m2/year			2451.6001	(272)
Emissions per m2 for space and water heating			14.2545	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7447	(272b)
Emissions per m2 for pumps and fans			0.2581	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2545 * 1.00) + 1.7447 + 0.2581, rounded to 2 d.p.			16.2600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1026	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3251	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3251	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4146	0.4064	0.3983	0.3577	0.3495	0.3089	0.3089	0.3008	0.3251	0.3495	0.3658	0.3820	(22b)
Effective ac	0.5859	0.5826	0.5793	0.5640	0.5611	0.5477	0.5477	0.5452	0.5529	0.5611	0.5669	0.5730	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.3530	74.9238	74.5032	72.5276	72.1580	70.4373	70.4373	70.1187	71.1001	72.1580	72.9058	73.6875	(38)
Heat transfer coeff	193.2553	192.8262	192.4056	190.4299	190.0603	188.3396	188.3396	188.0210	189.0024	190.0603	190.8081	191.5898	(39)
Average = Sum(39)m / 12 =												190.4282	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2815	1.2787	1.2759	1.2628	1.2603	1.2489	1.2489	1.2468	1.2533	1.2603	1.2653	1.2705	(40)
HLP (average)												1.2628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)

Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

36.0221	31.5051	32.5105	28.3434	27.1962	23.4682	21.7468	24.9547	25.2528	29.4297	32.1248	34.8854	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)

Water heating gains (Table 5)

48.4168	46.8826	43.6969	39.3659	36.5540	32.5948	29.2295	33.5413	35.0733	39.5560	44.6178	46.8890	(72)
Total internal gains												
465.5447	464.1362	447.7850	420.5254	391.1653	364.1519	347.4038	351.5900	366.2874	393.6987	425.3087	450.6342	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.4600	0.0000	0.7700	61.5448	(75)
Southeast	2.0700	36.7938	0.4600	0.0000	0.7700	26.9770	(77)
Southwest	5.1500	36.7938	0.4600	0.0000	0.7700	67.1167	(79)
Southwest	9.4900	36.7938	0.4600	0.0000	0.7700	123.6772	(79)

Solar gains	279.3158	496.2209	733.2506	999.5472	1202.6498	1230.4941	1171.1208	1014.0107	824.5900	563.0703	338.2788	236.6272	(83)
Total gains	744.8605	960.3570	1181.0356	1420.0726	1593.8151	1594.6460	1518.5246	1365.6007	1190.8774	956.7691	763.5875	687.2614	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.5089	30.5768	30.6437	30.9616	31.0218	31.3052	31.3052	31.3583	31.1954	31.0218	30.9002	30.7741	
alpha	3.0339	3.0385	3.0429	3.0641	3.0681	3.0870	3.0870	3.0906	3.0797	3.0681	3.0600	3.0516	
util living area													
	0.9910	0.9803	0.9565	0.8988	0.7917	0.6417	0.5040	0.5664	0.7880	0.9412	0.9841	0.9929	(86)
MIT	18.7152	19.0130	19.4738	20.0518	20.5332	20.8315	20.9413	20.9153	20.6618	20.0066	19.2477	18.6650	(87)
Th 2	19.8553	19.8576	19.8598	19.8701	19.8720	19.8811	19.8811	19.8827	19.8776	19.8720	19.8681	19.8640	(88)
util rest of house													
	0.9890	0.9761	0.9470	0.8760	0.7444	0.5598	0.3915	0.4524	0.7212	0.9235	0.9801	0.9914	(89)
MIT 2	17.7722	18.0693	18.5249	19.0906	19.5334	19.7866	19.8594	19.8485	19.6620	19.0609	18.3121	17.7285	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.8789	18.1760	18.6322	19.1993	19.6465	19.9048	19.9817	19.9691	19.7751	19.1678	18.4179	17.8344	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8789	18.1760	18.6322	19.1993	19.6465	19.9048	19.9817	19.9691	19.7751	19.1678	18.4179	17.8344	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9842	0.9676	0.9336	0.8596	0.7335	0.5617	0.4023	0.4620	0.7141	0.9088	0.9728	0.9874	(94)
Useful gains	733.0987	929.2541	1102.6545	1220.7006	1169.1119	895.6881	610.8612	630.8885	850.3894	869.5505	742.7814	678.6137	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2624.1859	2559.9565	2334.3067	1961.2860	1510.3053	999.0961	636.9048	671.0611	1072.5985	1628.3970	2159.5388	2612.2043	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1406.9689	1095.8320	916.3493	533.2215	253.8479	0.0000	0.0000	0.0000	0.0000	564.5818	1020.0653	1438.5913	(98)
Space heating												7229.4580	(98)
Space heating per m2											(98) / (4) =	47.9407	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1770.3925	1393.7132	1428.9594	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7975	0.8572	0.8208	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1411.9303	1194.6283	1172.9000	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1989.8859	1897.9526	1721.6752	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	416.1280	523.2733	408.2888	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1347.6901	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	104.0320	130.8183	102.0722	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												336.9225	(107)
Space cooling per m2												2.2342	(108)
Energy for space heating												47.9407	(99)
Energy for space cooling												2.2342	(108)
Total												50.1749	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1026	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3526	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3526	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4496	0.4408	0.4320	0.3879	0.3791	0.3350	0.3350	0.3262	0.3526	0.3791	0.3967	0.4144	(22b)
Effective ac	0.6011	0.5972	0.5933	0.5752	0.5719	0.5561	0.5561	0.5532	0.5622	0.5719	0.5787	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			32.1100	1.3258	42.5701			(27)
GF B&B J150 P/A=0.50			76.5900	0.1300	9.9567			(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.1800	24.6510			(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.1800	4.1526			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	2.3500		2.3500	0.1300	0.3055			(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9692			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.1491	(36)
Total fabric heat loss					(33) + (36) =		112.1183	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3013	76.7965	76.3018	73.9778	73.5430	71.5190	71.5190	71.1441	72.2986	73.5430	74.4226	75.3422	(38)
Heat transfer coeff	189.4196	188.9148	188.4201	186.0961	185.6613	183.6373	183.6373	183.2624	184.4169	185.6613	186.5409	187.4605	(39)
Average = Sum(39)m / 12 =												186.0940	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2561	1.2528	1.2495	1.2341	1.2312	1.2178	1.2178	1.2153	1.2229	1.2312	1.2370	1.2431	(40)
HLP (average)												1.2340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9354 (42)
Average daily hot water use (litres/day)		103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

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Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0221	31.5051	32.5105	28.3434	27.1962	23.4682	21.7468	24.9547	25.2528	29.4297	32.1248	34.8854	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	48.4168	46.8826	43.6969	39.3659	36.5540	32.5948	29.2295	33.5413	35.0733	39.5560	44.6178	46.8890	(72)
Total internal gains													
	465.5447	464.1362	447.7850	420.5254	391.1653	364.1519	347.4038	351.5900	366.2874	393.6987	425.3087	450.6342	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.6300	0.7000	0.7700	53.1025	(75)
Southeast	2.0700	36.7938	0.6300	0.7000	0.7700	23.2765	(77)
Southwest	14.6400	36.7938	0.6300	0.7000	0.7700	164.6220	(79)

Solar gains	241.0010	428.1523	632.6677	862.4354	1037.6776	1061.7024	1010.4736	874.9149	711.4778	485.8318	291.8758	204.1681	(83)
Total gains	706.5457	892.2885	1080.4527	1282.9608	1428.8429	1425.8543	1357.8774	1226.5049	1077.7651	879.5305	717.1845	654.8023	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2858	55.4336	55.5791	56.2732	56.4050	57.0267	57.0267	57.1433	56.7856	56.4050	56.1390	55.8636	
alpha	4.6857	4.6956	4.7053	4.7515	4.7603	4.8018	4.8018	4.8096	4.7857	4.7603	4.7426	4.7242	
util living area													
	0.9993	0.9978	0.9923	0.9691	0.8945	0.7393	0.5741	0.6474	0.8881	0.9870	0.9984	0.9995	(86)
MIT	19.4987	19.6849	19.9846	20.3814	20.7247	20.9255	20.9825	20.9699	20.8062	20.3477	19.8493	19.4722	(87)
Th 2	19.8754	19.8780	19.8806	19.8928	19.8951	19.9058	19.9058	19.9078	19.9017	19.8951	19.8905	19.8857	(88)
util rest of house													
	0.9991	0.9970	0.9893	0.9564	0.8513	0.6443	0.4418	0.5127	0.8241	0.9798	0.9977	0.9994	(89)
MIT 2	18.5041	18.6920	18.9923	19.3907	19.7079	19.8716	19.9015	19.8992	19.7900	19.3649	18.8664	18.4857	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	18.6166	18.8043	19.1045	19.5027	19.8228	19.9907	20.0237	20.0202	19.9049	19.4760	18.9775	18.5972	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6166	18.8043	19.1045	19.5027	19.8228	19.9907	20.0237	20.0202	19.9049	19.4760	18.9775	18.5972	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9958	0.9865	0.9506	0.8479	0.6524	0.4568	0.5276	0.8244	0.9759	0.9968	0.9991	(94)
Useful gains	705.5880	888.5784	1065.8136	1219.5871	1211.5537	930.2721	620.2494	647.1368	888.4666	858.3156	714.8767	654.1860	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2711.8357	2626.7247	2374.9335	1973.1179	1508.0979	989.9376	628.7156	663.4531	1070.5234	1647.9319	2215.6471	2698.9098	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1492.6483	1168.0343	973.9852	542.5422	220.6289	0.0000	0.0000	0.0000	0.0000	587.4745	1080.5547	1521.2745	(98)
Space heating												7587.1425	(98)
Space heating per m2											(98) / (4) =	50.3126	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1726.1902	1358.9157	1392.7944	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8429	0.9075	0.8710	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1454.9678	1233.2765	1213.1424	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1792.5969	1710.1831	1559.0957	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000   243.0929   354.8186   257.3892     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          855.3007 (104)
Cooled fraction                                                                                          fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
              0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000    60.7732    88.7046    64.3473     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          213.8252 (107)
Space cooling per m2                                                                                                                     1.4179 (108)
Energy for space heating                                                                                                                50.3126 (99)
Energy for space cooling                                                                                                                 1.4179 (108)
Total                                                                                                                                   51.7306 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                    59.5 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3508	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3683	0.3420	0.3508	0.3333	0.3333	0.3245	0.3157	0.3070	0.2982	0.3245	0.3070	0.3245	(22b)
Effective ac	0.5678	0.5585	0.5615	0.5555	0.5555	0.5526	0.5498	0.5471	0.5445	0.5526	0.5471	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.0265	71.8247	72.2154	71.4439	71.4439	71.0729	70.7119	70.3608	70.0195	71.0729	70.3608	71.0729	(38)
Heat transfer coeff	190.9288	189.7270	190.1177	189.3462	189.3462	188.9753	188.6142	188.2631	187.9218	188.9753	188.2631	188.9753	(39)
Average = Sum(39)m / 12 =												189.1212	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2661	1.2581	1.2607	1.2556	1.2556	1.2532	1.2508	1.2484	1.2462	1.2532	1.2484	1.2532	(40)
HLP (average)												1.2541	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.4405	(64)
RHI water heating demand												2212	(64)
Heat gains from water heating, kWh/month													
	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009	(72)
Total internal gains													
	797.1993	791.7528	762.3215	716.2482	668.2313	625.7858	601.3495	611.1422	637.9858	684.2966	735.8339	775.6383	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	14.6176	0.4600	0.0000	0.7700	79.7346	(75)
Southeast	2.0700	45.1778	0.4600	0.0000	0.7700	33.1241	(77)
Southwest	5.1500	45.1778	0.4600	0.0000	0.7700	82.4102	(79)
Southwest	9.4900	45.1778	0.4600	0.0000	0.7700	151.8588	(79)

Solar gains	347.1278	526.5847	789.2252	1089.8721	1251.1670	1392.1264	1313.9974	1162.7224	940.0858	646.0362	419.3894	288.8682	(83)
Total gains	1144.3271	1318.3375	1551.5467	1806.1203	1919.3983	2017.9121	1915.3469	1773.8647	1578.0716	1330.3328	1155.2232	1064.5065	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8807	31.0763	31.0124	31.1388	31.1388	31.1999	31.2596	31.3179	31.3748	31.1999	31.3179	31.1999	
alpha	3.0587	3.0718	3.0675	3.0759	3.0759	3.0800	3.0840	3.0879	3.0917	3.0800	3.0879	3.0800	
util living area													
	0.9689	0.9527	0.9104	0.8201	0.6847	0.4948	0.3714	0.3975	0.6388	0.8571	0.9465	0.9736	(86)
MIT	19.1886	19.4088	19.8470	20.3564	20.7272	20.9272	20.9776	20.9731	20.8370	20.3767	19.7286	19.1620	(87)
Th 2	19.8675	19.8738	19.8717	19.8758	19.8758	19.8777	19.8796	19.8815	19.8832	19.8777	19.8815	19.8777	(88)
util rest of house													
	0.9626	0.9435	0.8927	0.7854	0.6250	0.4101	0.2700	0.2904	0.5555	0.8200	0.9339	0.9682	(89)
MIT 2	17.4967	17.8157	18.4360	19.1365	19.6092	19.8268	19.8701	19.8698	19.7510	19.1852	18.2852	17.4652	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.6880	17.9958	18.5955	19.2744	19.7356	19.9512	19.9953	19.9945	19.8738	19.3199	18.4484	17.6570	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5380	17.8458	18.4455	19.1244	19.5856	19.8012	19.8453	19.8445	19.7238	19.1699	18.2984	17.5070	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9436	0.9201	0.8639	0.7580	0.6079	0.4040	0.2668	0.2867	0.5423	0.7908	0.9091	0.9510	(94)
Useful gains	1079.7814	1213.0606	1340.4483	1369.0790	1166.7937	815.1806	511.0805	508.5237	855.8233	1052.0130	1050.1622	1012.3440	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2412.9566	2380.2847	2175.9922	1822.3525	1341.6282	850.6205	517.8011	516.6972	944.0858	1468.3164	1957.6407	2363.5181	(97)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	991.8824	784.3746	621.6447	326.3569	130.0769	0.0000	0.0000	0.0000	0.0000	309.7297	653.3846	1005.2735 (98)
Space heating												4822.7232 (98)
RHI space heating demand												4823 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3508	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4473	0.4385	0.4297	0.3859	0.3771	0.3333	0.3333	0.3245	0.3508	0.3771	0.3947	0.4122	(22b)
Effective ac	0.6000	0.5961	0.5923	0.5745	0.5711	0.5555	0.5555	0.5526	0.5615	0.5711	0.5779	0.5850	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.1660	76.6665	76.1769	73.8771	73.4469	71.4439	71.4439	71.0729	72.2154	73.4469	74.3173	75.2273	(38)
Heat transfer coeff	195.0683	194.5688	194.0792	191.7795	191.3492	189.3462	189.3462	188.9753	190.1177	191.3492	192.2196	193.1296	(39)
Average = Sum(39)m / 12 =												191.7774	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2936	1.2902	1.2870	1.2717	1.2689	1.2556	1.2556	1.2532	1.2607	1.2689	1.2747	1.2807	(40)
HLP (average)												1.2717	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

```
Daily hot water use
              114.3081   110.1514   105.9948   101.8381    97.6815    93.5248    93.5248    97.6815   101.8381   105.9948   110.1514   114.3081 (44)
Energy conte   169.5156   148.2594   152.9905   133.3808   127.9820   110.4388   102.3378   117.4341   118.8366   138.4926   151.1755   164.1668 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1635.0105 (45)
Distribution loss  (46)m = 0.15 x (45)m
                25.4273    22.2389    22.9486    20.0071    19.1973    16.5658    15.3507    17.6151    17.8255    20.7739    22.6763    24.6250 (46)
Water storage loss:
Store volume                                                                                                                                210.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                 1.5400 (48)
  Temperature factor from Table 2b                                                                                                          0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                  0.8316 (55)
Total storage loss
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (56)
If cylinder contains dedicated solar storage
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              218.5576   192.5554   202.0325   180.8408   177.0240   157.8988   151.3798   166.4761   166.2966   187.5346   198.6355   213.2088 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
              218.5576   192.5554   202.0325   180.8408   177.0240   157.8988   151.3798   166.4761   166.2966   187.5346   198.6355   213.2088 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   2212.4405 (64)
Heat gains from water heating, kWh/month
                95.5975    84.7331    90.1029    82.3171    81.7876    74.6889    73.2609    78.2804    77.4812    85.2824    88.2339    93.8191 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                71.7627    63.7390    51.8360    39.2432    29.3348    24.7656    26.7601    34.7839    46.6868    59.2796    69.1881    73.7572 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               479.6887   484.6664   472.1228   445.4191   411.7104   380.0289   358.8638   353.8861   366.4297   393.1335   426.8422   458.5236 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172 (71)
Water heating gains (Table 5)
               128.4913   126.0909   121.1061   114.3293   109.9296   103.7346    98.4690   105.2156   107.6127   114.6269   122.5470   126.1009 (72)
Total internal gains
               797.1993   791.7528   762.3215   716.2482   668.2313   625.7858   601.3495   611.1422   637.9858   684.2966   735.8339   775.6383 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data    Specific data        factor                W
                                                          W/m2      or Table 6b      or Table 6c      Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                               15.4000          11.2829           0.4600           0.0000           0.7700           61.5448 (75)
Southeast                                2.0700          36.7938           0.4600           0.0000           0.7700           26.9770 (77)
Southwest                                5.1500          36.7938           0.4600           0.0000           0.7700           67.1167 (79)
Southwest                                9.4900          36.7938           0.4600           0.0000           0.7700          123.6772 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    279.3158   496.2209   733.2506   999.5472  1202.6498  1230.4941  1171.1208  1014.0107   824.5900   563.0703   338.2788   236.6272 (83)
Total gains   1076.5152  1287.9737  1495.5721  1715.7954  1870.8811  1856.2799  1772.4704  1625.1529  1462.5758  1247.3669  1074.1127  1012.2655 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           30.2254    30.3030    30.3794    30.7437    30.8128    31.1388    31.1388    31.1999    31.0124    30.8128    30.6733    30.5288
alpha          3.0150     3.0202     3.0253     3.0496     3.0542     3.0759     3.0759     3.0800     3.0675     3.0542     3.0449     3.0353
util living area
                0.9760     0.9586     0.9249     0.8529     0.7342     0.5787     0.4444     0.4956     0.7117     0.8945     0.9617     0.9798 (86)

MIT            18.9807    19.2621    19.6885    20.2112    20.6261    20.8729    20.9580    20.9410    20.7500    20.1948    19.4930    18.9317 (87)
Th 2           19.8459    19.8485    19.8510    19.8630    19.8653    19.8758    19.8758    19.8777    19.8717    19.8653    19.8607    19.8560 (88)
util rest of house
                0.9711     0.9505     0.9100     0.8236     0.6819     0.4980     0.3408     0.3892     0.6377     0.8666     0.9528     0.9757 (89)
MIT 2          17.1831    17.5895    18.1996    18.9338    19.4786    19.7748    19.8539    19.8443    19.6491    18.9320    17.9355    17.1183 (90)
Living area fraction                                                                                        fLA = Living area / (4) =      0.1131 (91)
MIT            17.3864    17.7786    18.3679    19.0782    19.6083    19.8990    19.9787    19.9683    19.7736    19.0748    18.1116    17.3233 (92)
Temperature adjustment                                                                                                                  -0.1500
adjusted MIT   17.2364    17.6286    18.2179    18.9282    19.4583    19.7490    19.8287    19.8183    19.6236    18.9248    17.9616    17.1733 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9546     0.9282     0.8818     0.7942     0.6606     0.4881     0.3362     0.3832     0.6190     0.8366     0.9311     0.9609 (94)
Useful gains  1027.6026  1195.4915  1318.7592  1362.7223  1235.9714   906.0872   595.9865   622.7253   905.2976  1043.5008  1000.1580   972.7110 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             2523.4767  2476.5924  2274.2025  1923.2055  1484.5490   974.9391   611.3438   645.9668  1050.1256  1592.9360  2087.8184  2505.5286 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating kWh

1112.9303	860.8999	710.8498	403.5479	184.9417	0.0000	0.0000	0.0000	0.0000	408.7798	783.1155	1140.4163	(98)

Space heating 5605.4811 (98)
Space heating per m2 (98) / (4) = 37.1716 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 6187.0652 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1112.9303	860.8999	710.8498	403.5479	184.9417	0.0000	0.0000	0.0000	0.0000	408.7798	783.1155	1140.4163	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1228.3999	950.2206	784.6024	445.4171	204.1300	0.0000	0.0000	0.0000	0.0000	451.1918	864.3659	1258.7377	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.6513	88.4353	87.9921	86.9948	85.0310	79.9000	79.9000	79.9000	79.9000	86.9385	88.2099	88.7284	(217)
Fuel for water heating, kWh/month													
	246.5363	217.7360	229.6029	207.8753	208.1877	197.6205	189.4615	208.3555	208.1309	215.7094	225.1850	240.2937	(219)
Water heating fuel used												2594.6949	(219)

Annual totals kWh/year
Space heating fuel - main system 6187.0652 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 506.9406 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 8145.1437 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6187.0652	3.4800	215.3099	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2594.6949	3.4800	90.2954	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	506.9406	13.1900	66.8655	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			341.6355	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.7328 (257)
SAP value 89.7771
SAP rating (Section 12) 90 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6187.0652	0.2160	1336.4061	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.6949	0.2160	560.4541	(264)
Space and water heating			1896.8602	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1566.4562	(272)
CO2 emissions per m2			10.3900	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	89.2796
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8505 = 4.092, stars = 4
Water heating environmental impact	0.216 / 0.8505 = 0.2540, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3508	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3683	0.3420	0.3508	0.3333	0.3333	0.3245	0.3157	0.3070	0.2982	0.3245	0.3070	0.3245	(22b)
Effective ac	0.5678	0.5585	0.5615	0.5555	0.5555	0.5526	0.5498	0.5471	0.5445	0.5526	0.5471	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.0265	71.8247	72.2154	71.4439	71.4439	71.0729	70.7119	70.3608	70.0195	71.0729	70.3608	71.0729	(38)
Heat transfer coeff	190.9288	189.7270	190.1177	189.3462	189.3462	188.9753	188.6142	188.2631	187.9218	188.9753	188.2631	188.9753	(39)
Average = Sum(39)m / 12 =												189.1212	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2661	1.2581	1.2607	1.2556	1.2556	1.2532	1.2508	1.2484	1.2462	1.2532	1.2484	1.2532	(40)
HLP (average)												1.2541	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Daily hot water use													
	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.4405	(64)
Heat gains from water heating, kWh/month													
	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009	(72)
Total internal gains													
	797.1993	791.7528	762.3215	716.2482	668.2313	625.7858	601.3495	611.1422	637.9858	684.2966	735.8339	775.6383	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	14.6176	0.4600	0.0000	0.7700	79.7346	(75)
Southeast	2.0700	45.1778	0.4600	0.0000	0.7700	33.1241	(77)
Southwest	5.1500	45.1778	0.4600	0.0000	0.7700	82.4102	(79)
Southwest	9.4900	45.1778	0.4600	0.0000	0.7700	151.8588	(79)

Solar gains	347.1278	526.5847	789.2252	1089.8721	1251.1670	1392.1264	1313.9974	1162.7224	940.0858	646.0362	419.3894	288.8682	(83)
Total gains	1144.3271	1318.3375	1551.5467	1806.1203	1919.3983	2017.9121	1915.3469	1773.8647	1578.0716	1330.3328	1155.2232	1064.5065	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8807	31.0763	31.0124	31.1388	31.1388	31.1999	31.2596	31.3179	31.3748	31.1999	31.3179	31.1999	
alpha	3.0587	3.0718	3.0675	3.0759	3.0759	3.0800	3.0840	3.0879	3.0917	3.0800	3.0879	3.0800	
util living area													
	0.9689	0.9527	0.9104	0.8201	0.6847	0.4948	0.3714	0.3975	0.6388	0.8571	0.9465	0.9736	(86)
MIT	19.1886	19.4088	19.8470	20.3564	20.7272	20.9272	20.9776	20.9731	20.8370	20.3767	19.7286	19.1620	(87)
Th 2	19.8675	19.8738	19.8717	19.8758	19.8758	19.8777	19.8796	19.8815	19.8832	19.8777	19.8815	19.8777	(88)
util rest of house													
	0.9626	0.9435	0.8927	0.7854	0.6250	0.4101	0.2700	0.2904	0.5555	0.8200	0.9339	0.9682	(89)
MIT 2	17.4967	17.8157	18.4360	19.1365	19.6092	19.8268	19.8701	19.8698	19.7510	19.1852	18.2852	17.4652	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.6880	17.9958	18.5955	19.2744	19.7356	19.9512	19.9953	19.9945	19.8738	19.3199	18.4484	17.6570	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5380	17.8458	18.4455	19.1244	19.5856	19.8012	19.8453	19.8445	19.7238	19.1699	18.2984	17.5070	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9436	0.9201	0.8639	0.7580	0.6079	0.4040	0.2668	0.2867	0.5423	0.7908	0.9091	0.9510	(94)
Useful gains	1079.7814	1213.0606	1340.4483	1369.0790	1166.7937	815.1806	511.0805	508.5237	855.8233	1052.0130	1050.1622	1012.3440	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2412.9566	2380.2847	2175.9922	1822.3525	1341.6282	850.6205	517.8011	516.6972	944.0858	1468.3164	1957.6407	2363.5181	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating kWh
991.8824 784.3746 621.6447 326.3569 130.0769 0.0000 0.0000 0.0000 0.0000 309.7297 653.3846 1005.2735 (98)
Space heating 4822.7232 (98)
Space heating per m2 (98) / (4) = 31.9809 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5323.0941 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	991.8824	784.3746	621.6447	326.3569	130.0769	0.0000	0.0000	0.0000	0.0000	309.7297	653.3846	1005.2735	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1094.7929	865.7556	686.1420	360.2173	143.5728	0.0000	0.0000	0.0000	0.0000	341.8650	721.1750	1109.5734	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4610	88.2701	87.7187	86.4712	84.1073	79.9000	79.9000	79.9000	79.9000	86.2443	87.8570	88.5256	(217)
Fuel for water heating, kWh/month													
	247.0666	218.1435	230.3187	209.1342	210.4739	197.6205	189.4615	208.3555	208.1309	217.4459	226.0895	240.8442	(219)
Water heating fuel used												2603.0851	(219)
Annual totals kWh/year													
Space heating fuel - main system												5323.0941	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												7139.1426	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5323.0941	10.2300	544.5525	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2603.0851	10.2300	266.2956	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	506.9406	36.7200	186.1486	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			624.8483	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5323.0941	0.2160	1149.7883	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2603.0851	0.2160	562.2664	(264)
Space and water heating			1712.0547	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			1303.5827	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5323.0941	1.2200	6494.1748	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2603.0851	1.2200	3175.7638	(264)
Space and water heating			9669.9385	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	506.9406	3.0700	1556.3077 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			7253.7365 (272)
Primary energy kWh/m2/year			48.1017 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 89

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 122	-270 kg (20.7%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£122	1.79 kg/m²	B 91	B 91
	Total Savings	£122	1.79 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£214	£232	-£18
Mains gas	£914	£774	£140
Space heating	£675	£679	-£3
Water heating	£266	£141	£125
Lighting	£186	£186	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£625	£503	£122
Total cost of uses	£624	£503	£122
Delivered energy	47 kWh/m²	39 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.0 tonnes	0.3 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	48 kWh/m²	38 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		4.4500	
Infiltration rate		0.3508	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4473	0.4385	0.4297	0.3859	0.3771	0.3333	0.3333	0.3245	0.3508	0.3771	0.3947	0.4122	(22b)
Effective ac	0.6000	0.5961	0.5923	0.5745	0.5711	0.5555	0.5555	0.5526	0.5615	0.5711	0.5779	0.5850	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.1660	76.6665	76.1769	73.8771	73.4469	71.4439	71.4439	71.0729	72.2154	73.4469	74.3173	75.2273	(38)
Heat transfer coeff	195.0683	194.5688	194.0792	191.7795	191.3492	189.3462	189.3462	188.9753	190.1177	191.3492	192.2196	193.1296	(39)
Average = Sum(39)m / 12 =												191.7774	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2936	1.2902	1.2870	1.2717	1.2689	1.2556	1.2556	1.2532	1.2607	1.2689	1.2747	1.2807	(40)
HLP (average)												1.2717	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Daily hot water use
              114.3081   110.1514   105.9948   101.8381    97.6815    93.5248    93.5248    97.6815   101.8381   105.9948   110.1514   114.3081 (44)
Energy conte   169.5156   148.2594   152.9905   133.3808   127.9820   110.4388   102.3378   117.4341   118.8366   138.4926   151.1755   164.1668 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1635.0105 (45)
Distribution loss  (46)m = 0.15 x (45)m
                25.4273    22.2389    22.9486    20.0071    19.1973    16.5658    15.3507    17.6151    17.8255    20.7739    22.6763    24.6250 (46)
Water storage loss:
Store volume                                                                                                                                 210.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                  1.5400 (48)
  Temperature factor from Table 2b                                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                     0.8316 (55)
Total storage loss
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (56)
If cylinder contains dedicated solar storage
                16.5726    14.9688    16.5726    16.0380    16.5726    16.0380    16.5726    16.5726    16.0380    16.5726    16.0380    16.5726 (57)
Primary loss    23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              209.3506   184.2394   191.4297   165.1772   155.0227   136.3821   129.1458   145.1726   151.9837   176.9319   189.7255   204.0018 (62)
Aperture area of solar collector                                                                                                               3.0000 (H1)
Zero-loss collector efficiency                                                                                                                 0.7000 (H2)
Collector heat loss coefficient                                                                                                                1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                                      0.0050 (H3a)
Collector effective heat loss coefficient                                                                                                      1.8063 (H3b)
Collector performance ratio                                                                                                                    2.5804 (H4)
Annual solar radiation per m2                                                                                                               1079.5246 (H5)
Overshading factor                                                                                                                             0.8000 (H6)
Solar energy available                                                                                                                      1813.6014 (H7)
Adjustment factor for showers                                                                                                                  1.0000 (H7a)
Solar-to-load ratio                                                                                                                            1.1092 (H8)
Utilisation factor                                                                                                                             0.5941 (H9)
Collector performance factor                                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                                75.0000 (H11)
Effective solar volume                                                                                                                       115.5000 (H13)
Daily hot water demand                                                                                                                       103.9165 (H14)
Volume ratio Veff/V                                                                                                                            1.1115 (H15)
Solar storage volume factor                                                                                                                    1.0000 (H16)
Solar input                                                                                                                                 -947.3254 (H17)
Solar input    -27.4705   -45.8404   -78.0715  -104.6312  -129.2631  -127.0862  -125.4067  -109.5685   -85.8141   -58.6009   -32.5840   -22.9882 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -947.3254 (63)
Output from w/h
              181.8801   138.3990   113.3582    60.5460    25.7597     9.2959     3.7391    35.6042    66.1697   118.3310   157.1415   181.0137 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1091.2378 (64)
Heat gains from water heating, kWh/month
                88.2319    78.0803    81.6207    69.7862    64.1866    57.4755    55.4737    61.2377    66.0309    76.8002    81.1059    86.4535 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                71.7627    63.7390    51.8360    39.2432    29.3348    24.7656    26.7601    34.7839    46.6868    59.2796    69.1881    73.7572 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              479.6887   484.6664   472.1228   445.4191   411.7104   380.0289   358.8638   353.8861   366.4297   393.1335   426.8422   458.5236 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172 (71)
Water heating gains (Table 5)
              118.5913   116.1909   109.7053    96.9253    86.2723    79.8271    74.5615    82.3087    91.7095   103.2261   112.6470   116.2009 (72)
Total internal gains
              787.2993   781.8528   750.9207   698.8442   644.5740   601.8783   577.4420   588.2353   622.0826   672.8958   725.9339   765.7383 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data      factor              W
                                                         W/m2         or Table 6b      or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                              15.4000          11.2829           0.4600           0.0000           0.7700          61.5448 (75)
Southeast                               2.0700          36.7938           0.4600           0.0000           0.7700          26.9770 (77)
Southwest                               5.1500          36.7938           0.4600           0.0000           0.7700          67.1167 (79)
Southwest                               9.4900          36.7938           0.4600           0.0000           0.7700         123.6772 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    279.3158   496.2209   733.2506   999.5472  1202.6498  1230.4941  1171.1208  1014.0107   824.5900   563.0703   338.2788   236.6272 (83)
Total gains   1066.6152  1278.0737  1484.1713  1698.3914  1847.2238  1832.3724  1748.5629  1602.2460  1446.6726  1235.9661  1064.2127  1002.3655 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                   21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            30.2254    30.3030    30.3794    30.7437    30.8128    31.1388    31.1388    31.1999    31.0124    30.8128    30.6733    30.5288
alpha           3.0150     3.0202     3.0253     3.0496     3.0542     3.0759     3.0759     3.0800     3.0675     3.0542     3.0449     3.0353
util living area
                0.9765     0.9594     0.9262     0.8557     0.7391     0.5843     0.4497     0.5014     0.7161     0.8965     0.9626     0.9803 (86)

MIT            18.9725    19.2543    19.6806    20.2020    20.6185    20.8695    20.9567    20.9390    20.7454    20.1877    19.4851    18.9233 (87)
Th 2           19.8459    19.8485    19.8510    19.8630    19.8653    19.8758    19.8758    19.8777    19.8717    19.8653    19.8607    19.8560 (88)
util rest of house
                0.9718     0.9514     0.9114     0.8268     0.6871     0.5033     0.3451     0.3942     0.6423     0.8690     0.9539     0.9763 (89)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.1712	17.5784	18.1886	18.9218	19.4699	19.7718	19.8531	19.8431	19.6444	18.9226	17.9243	17.1061 (90)
Living area fraction										fLA = Living area / (4) =		0.1131 (91)
MIT	17.3749	17.7679	18.3573	19.0665	19.5997	19.8959	19.9779	19.9670	19.7689	19.0657	18.1008	17.3116 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.2249	17.6179	18.2073	18.9165	19.4497	19.7459	19.8279	19.8170	19.6189	18.9157	17.9508	17.1616 (93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9555	0.9293	0.8834	0.7973	0.6655	0.4931	0.3404	0.3880	0.6233	0.8390	0.9324	0.9618	(94)
Useful gains	1019.1177	1187.7126	1311.0830	1354.1488	1229.3187	903.5802	595.2885	621.6695	901.6699	1036.9498	992.3093	964.0507	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2521.2298	2474.5100	2272.1371	1920.9605	1482.9075	974.3618	611.1826	645.7230	1049.2427	1591.1965	2085.7356	2503.2604	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1117.5714	864.7279	715.0243	408.1045	188.6701	0.0000	0.0000	0.0000	0.0000	412.3595	787.2669	1145.1720	(98)
Space heating												5638.8966	(98)
Space heating per m2											(98) / (4) =	37.3932	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6223.9477	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1117.5714	864.7279	715.0243	408.1045	188.6701	0.0000	0.0000	0.0000	0.0000	412.3595	787.2669	1145.1720	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1233.5226	954.4458	789.2100	450.4464	208.2451	0.0000	0.0000	0.0000	0.0000	455.1430	868.9480	1263.9868	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	181.8801	138.3990	113.3582	60.5460	25.7597	9.2959	3.7391	35.6042	66.1697	118.3310	157.1415	181.0137	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9330	88.9564	88.9696	89.0592	89.1655	79.9000	79.9000	79.9000	79.9000	87.9731	88.6252	88.9737	(217)
Fuel for water heating, kWh/month	204.5135	155.5807	127.4123	67.9840	28.8897	11.6344	4.6797	44.5609	82.8156	134.5081	177.3102	203.4463	(219)
Water heating fuel used												1243.3353	(219)
Annual totals kWh/year													
Space heating fuel - main system												6223.9477	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6880.6666	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6223.9477	3.4800	216.5934	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1243.3353	3.4800	43.2681	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	506.9406	13.1900	66.8655	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			302.4867	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6488	(257)
SAP value	90.9486	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)			91 (258)
SAP band			B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6223.9477	0.2160	1344.3727	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1243.3353	0.2160	268.5604	(264)
Space and water heating			1612.9331	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1308.4792	(272)
CO2 emissions per m2			8.6800	(273)
EI value			91.0451	
EI rating			91	(274)
EI band			B	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1283	(8)
Pressure test			Yes	
Measured/design AP50			4.4500	
Infiltration rate			0.3508	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3508	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3683	0.3420	0.3508	0.3333	0.3333	0.3245	0.3157	0.3070	0.2982	0.3245	0.3070	0.3245	(22b)
Effective ac	0.5678	0.5585	0.5615	0.5555	0.5555	0.5526	0.5498	0.5471	0.5445	0.5526	0.5471	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3040	(36)
Total fabric heat loss					(33) + (36) =		117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.0265	71.8247	72.2154	71.4439	71.4439	71.0729	70.7119	70.3608	70.0195	71.0729	70.3608	71.0729	(38)
Heat transfer coeff	190.9288	189.7270	190.1177	189.3462	189.3462	188.9753	188.6142	188.2631	187.9218	188.9753	188.2631	188.9753	(39)
Average = Sum(39)m / 12 =												189.1212	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2661	1.2581	1.2607	1.2556	1.2556	1.2532	1.2508	1.2484	1.2462	1.2532	1.2484	1.2532	(40)
HLP (average)												1.2541	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081 (44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668 (45)
Energy content (annual)										Total = Sum(45)m =		1635.0105 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8316 (55)
Total storage loss												
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (56)
If cylinder contains dedicated solar storage												
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	209.3506	184.2394	191.4297	165.1772	155.0227	136.3821	129.1458	145.1726	151.9837	176.9319	189.7255	204.0018 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2414 (H8)
Utilisation factor												0.5532 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												103.9165 (H14)
Volume ratio Veff/V												1.1115 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-987.2153 (H17)
Solar input	-32.2053	-45.7940	-78.7088	-106.1964	-124.7341	-133.2357	-130.4337	-116.7421	-91.4010	-63.1915	-38.0904	-26.4822 (63)
								Solar input (sum of months) = Sum(63)m =				-987.2153 (63)
Output from w/h												
	177.1453	138.4455	112.7209	58.9808	30.2887	3.1464	0.0000	28.4305	60.5827	113.7403	151.6351	177.5197 (64)
								Total per year (kWh/year) = Sum(64)m =				1052.6357 (64)
Heat gains from water heating, kWh/month												
	88.2319	78.0803	81.6207	69.7862	64.1866	57.4755	55.4737	61.2377	66.0309	76.8002	81.1059	86.4535 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	118.5913	116.1909	109.7053	96.9253	86.2723	79.8271	74.5615	82.3087	91.7095	103.2261	112.6470	116.2009	(72)
Total internal gains													
	787.2993	781.8528	750.9207	698.8442	644.5740	601.8783	577.4420	588.2353	622.0826	672.8958	725.9339	765.7383	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	14.6176	0.4600	0.0000	0.7700	79.7346	(75)
Southeast	2.0700	45.1778	0.4600	0.0000	0.7700	33.1241	(77)
Southwest	5.1500	45.1778	0.4600	0.0000	0.7700	82.4102	(79)
Southwest	9.4900	45.1778	0.4600	0.0000	0.7700	151.8588	(79)

Solar gains	347.1278	526.5847	789.2252	1089.8721	1251.1670	1392.1264	1313.9974	1162.7224	940.0858	646.0362	419.3894	288.8682	(83)
Total gains	1134.4271	1308.4375	1540.1459	1788.7163	1895.7410	1994.0047	1891.4394	1750.9577	1562.1684	1318.9320	1145.3232	1054.6065	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8807	31.0763	31.0124	31.1388	31.1388	31.1999	31.2596	31.3179	31.3748	31.1999	31.3179	31.1999	
alpha	3.0587	3.0718	3.0675	3.0759	3.0759	3.0800	3.0840	3.0879	3.0917	3.0800	3.0879	3.0800	
util living area													
	0.9696	0.9536	0.9118	0.8232	0.6898	0.4996	0.3757	0.4022	0.6431	0.8595	0.9476	0.9743	(86)
MIT	19.1805	19.4011	19.8394	20.3483	20.7211	20.9252	20.9769	20.9722	20.8338	20.3705	19.7211	19.1537	(87)
Th 2	19.8675	19.8738	19.8717	19.8758	19.8758	19.8777	19.8796	19.8815	19.8832	19.8777	19.8815	19.8777	(88)
util rest of house													
	0.9634	0.9445	0.8944	0.7888	0.6303	0.4144	0.2733	0.2940	0.5598	0.8227	0.9352	0.9689	(89)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.4851	17.8049	18.4256	19.1263	19.6027	19.8253	19.8697	19.8694	19.7482	19.1774	18.2747	17.4533 (90)
Living area fraction										fLA = Living area / (4) =		0.1131 (91)
MIT	17.6768	17.9853	18.5855	19.2644	19.7292	19.9497	19.9949	19.9941	19.8709	19.3123	18.4383	17.6455 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5268	17.8353	18.4355	19.1144	19.5792	19.7997	19.8449	19.8441	19.7209	19.1623	18.2883	17.4955 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9446	0.9213	0.8657	0.7613	0.6128	0.4082	0.2700	0.2902	0.5463	0.7934	0.9106	0.9520	(94)
Useful gains	1071.6099	1205.5058	1333.2534	1361.6651	1161.7146	813.8693	510.7785	508.1490	853.4816	1046.4983	1042.8861	1003.9751	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2410.8105	2378.2924	2174.0872	1820.4574	1340.4136	850.3242	517.7300	516.6090	943.5369	1466.8842	1955.7263	2361.3440	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	996.3652	788.1126	625.5804	330.3305	132.9521	0.0000	0.0000	0.0000	0.0000	312.7672	657.2450	1009.8824	(98)
Space heating												4853.2353	(98)
Space heating per m2											(98) / (4) =	32.1833	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5356.7718	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	996.3652	788.1126	625.5804	330.3305	132.9521	0.0000	0.0000	0.0000	0.0000	312.7672	657.2450	1009.8824	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1099.7409	869.8815	690.4861	364.6031	146.7462	0.0000	0.0000	0.0000	0.0000	345.2176	725.4359	1114.6605	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	177.1453	138.4455	112.7209	58.9808	30.2887	3.1464	0.0000	28.4305	60.5827	113.7403	151.6351	177.5197	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8048	88.8227	88.7847	88.7984	88.4034	79.9000	79.9000	79.9000	79.9000	87.4760	88.3812	88.8217	(217)
Fuel for water heating, kWh/month	199.4772	155.8673	126.9598	66.4210	34.2619	3.9379	0.0000	35.5826	75.8232	130.0246	171.5693	199.8607	(219)
Water heating fuel used												1199.7854	(219)
Annual totals kWh/year													
Space heating fuel - main system												5356.7718	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												5819.5208	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5356.7718	10.2300	547.9978	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1199.7854	10.2300	122.7380	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	506.9406	36.7200	186.1486	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			503.0960	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5356.7718	0.2160	1157.0627	(261)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1199.7854	0.2160	259.1537	(264)
Space and water heating			1416.2164	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			1033.6944	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5356.7718	1.2200	6535.2616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1199.7854	1.2200	1463.7382	(264)
Space and water heating			7998.9999	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	506.9406	3.0700	1556.3077	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			5736.2978	(272)
Primary energy kWh/m2/year			38.0391	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	140.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		514.42 (P1)
Transmission heat loss coefficient		117.90 (37)
Summer heat loss coefficient		632.32 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	15.4000	106.0502	0.4600	0.0000	0.9000	676.1338
South East	2.0700	127.3119	0.4600	0.0000	0.9000	109.1037
South West	5.1500	127.3119	0.4600	0.0000	0.9000	271.4416
South West	9.4900	127.3119	0.4600	0.0000	0.9000	500.1905
total:						1556.8695

	Jun	Jul	Aug	
Solar gains	1677	1557	1373	(P4)
Internal gains	623	598	608	
Total summer gains	2299	2155	1981	(P5)
Summer gain/loss ratio	3.64	3.41	3.13	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 140.8)	1.01	1.01	1.01	
Threshold temperature	20.05	21.72	21.45	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-327	**Issued on Date**	28/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Richmond-As-DET
Property	29, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.49	**TER**	16.58
Environmental	90 B	**% DER<TER**	30.72		
CO_2 Emissions (t/year)	1.10	**DFEE**	48.54	**TFEE**	56.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.54		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 131 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.49 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.29 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.68 m², No overhang
Windows facing South West: 10.76 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.026 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1476	(8)
Pressure test				Yes	
Measured/design AP50				4.2900	
Infiltration rate				0.3621	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4616	0.4526	0.4435	0.3983	0.3892	0.3440	0.3440	0.3349	0.3621	0.3892	0.4073	0.4254	(22b)
Effective ac	0.6066	0.6024	0.5984	0.5793	0.5757	0.5592	0.5592	0.5561	0.5655	0.5757	0.5830	0.5905	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19371.7010 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.7853 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.8231	67.3605	66.9070	64.7770	64.3785	62.5233	62.5233	62.1798	63.2379	64.3785	65.1847	66.0275	(38)
Heat transfer coeff	159.2724	158.8097	158.3562	156.2262	155.8277	153.9726	153.9726	153.6290	154.6872	155.8277	156.6339	157.4768	(39)
Average = Sum(39)m / 12 =												156.2243	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2115	1.2081	1.1918	1.1888	1.1746	1.1746	1.1720	1.1801	1.1888	1.1949	1.2014	(40)
HLP (average)												1.1918	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	521.4710	518.9998	501.5003	473.1227	443.8038	416.0943	398.4746	405.2546	420.1887	448.8016	481.6107	506.7017	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	692.3918	820.3361	940.8809	1062.9255	1145.8610	1131.2978	1080.4234	1000.6706	911.2226	789.1436	688.1910	651.7730	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7851	33.8835	33.9805	34.4438	34.5319	34.9480	34.9480	35.0261	34.7865	34.5319	34.3542	34.1703	
alpha	3.2523	3.2589	3.2654	3.2963	3.3021	3.3299	3.3299	3.3351	3.3191	3.3021	3.2903	3.2780	
util living area													
	0.9907	0.9832	0.9672	0.9283	0.8484	0.7134	0.5701	0.6227	0.8251	0.9501	0.9844	0.9923	(86)
MIT	18.9463	19.1772	19.5552	20.0541	20.5002	20.8125	20.9353	20.9120	20.6687	20.0876	19.4313	18.9128	(87)
Th 2	19.9080	19.9108	19.9135	19.9265	19.9290	19.9403	19.9403	19.9424	19.9360	19.9290	19.9240	19.9189	(88)
util rest of house													
	0.9887	0.9795	0.9597	0.9108	0.8087	0.6352	0.4541	0.5088	0.7649	0.9345	0.9804	0.9907	(89)
MIT 2	17.1629	17.5003	18.0493	18.7697	19.3833	19.7806	19.9038	19.8884	19.6194	18.8298	17.8804	17.1206	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.3618	17.6873	18.2172	18.9129	19.5079	19.8957	20.0189	20.0026	19.7365	18.9701	18.0534	17.3205	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2118	17.5373	18.0672	18.7629	19.3579	19.7457	19.8689	19.8526	19.5865	18.8201	17.9034	17.1705	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9806	0.9672	0.9413	0.8856	0.7829	0.6188	0.4456	0.4980	0.7404	0.9114	0.9686	0.9838	(94)
Useful gains	678.9423	793.4658	885.6969	941.3004	897.0695	700.0542	481.3861	498.3597	674.7072	719.2456	666.5833	641.1970	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2056.4941	2006.9319	1831.7443	1540.8469	1193.3063	792.3005	503.3142	530.4150	848.6869	1280.9184	1692.1737	2042.5517	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1024.8985	815.4492	703.8592	431.6735	220.4002	0.0000	0.0000	0.0000	0.0000	417.8846	738.4251	1042.6079	(98)
Space heating												5395.1982	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 41.1596 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5968.1396 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1024.8985	815.4492	703.8592	431.6735	220.4002	0.0000	0.0000	0.0000	0.0000	417.8846	738.4251	1042.6079	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1133.7373	902.0456	778.6054	477.5149	243.8056	0.0000	0.0000	0.0000	0.0000	462.2617	816.8419	1153.3273	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3518	88.1782	87.8164	87.0084	85.3644	79.7000	79.7000	79.7000	79.7000	86.8469	87.9410	88.4208	(217)
Fuel for water heating, kWh/month	242.1193	213.6644	224.9396	202.9846	202.3570	193.0607	184.8401	203.6183	203.5067	210.9009	220.8926	235.9331	(219)
Water heating fuel used												2538.8172	(219)

Annual totals kWh/year
Space heating fuel - main system 5968.1396 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 504.5329 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 7867.9327 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5968.1396	0.2160	1289.1182	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2538.8172	0.2160	548.3845	(264)
Space and water heating			1837.5027	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1505.8491	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4900	ZC1
Total Floor Area	TFA	131.0800	
Assumed number of occupants	N	2.8977	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5178	ZC2
CO2 emissions from cooking, equation (L16)		1.4384	ZC3
Total CO2 emissions		26.4462	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.4462	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)

Water storage loss:	
Store volume	170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5003 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.8102 (55)
Total storage loss
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (56)
If cylinder contains dedicated solar storage
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2190.5335 (64)
Heat gains from water heating, kWh/month
               94.5805    83.8284    89.1333    81.4208    80.8896    73.8582    72.4363    77.4126    76.6265    84.3542    87.2865    92.8174 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                28.5687    25.3745    20.6359    15.6227    11.6782     9.8592    10.6532    13.8475    18.5860    23.5992    27.5438    29.3628 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               299.0175   302.1204   294.3013   277.6553   256.6427   236.8939   223.7004   220.5976   228.4167   245.0627   266.0752   285.8241 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094 (71)
Water heating gains (Table 5)
               127.1244   124.7446   119.8028   113.0844   108.7226   102.5809    97.3607   104.0492   106.4257   113.3794   121.2313   124.7545 (72)
Total internal gains
               524.1767   521.7055   504.2060   475.8284   446.5095   418.8000   401.1803   407.9603   422.8944   451.5073   484.3164   509.4074 (73)
```

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6. Solar gains

```
[Jan]                                    Area        Solar flux          g              FF           Access          Gains
                                          m2          Table 6a     Specific data  Specific data     factor           W
                                                        W/m2       or Table 6b    or Table 6c     Table 6d
-------------------------------------------------------------------------------------------------------------------------
Northeast                                7.6800         11.2829          0.6300         0.7000         0.7700      26.4823 (75)
Southwest                               10.7600         36.7938          0.6300         0.7000         0.7700     120.9927 (79)
-------------------------------------------------------------------------------------------------------------------------

Solar gains  147.4750   260.0008   379.1091   508.8972   605.7533   617.0962   588.4032   513.7405   423.6768   293.6560   178.2429   125.1713 (83)
Total gains  671.6517   781.7063   883.3151   984.7257  1052.2628  1035.8962   989.5836   921.7007   846.5712   745.1633   662.5593   634.5787 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          59.5268    59.7135    59.8976    60.7779    60.9455    61.7379    61.7379    61.8869    61.4302    60.9455    60.6074    60.2580
alpha         4.9685     4.9809     4.9932     5.0519     5.0630     5.1159     5.1159     5.1258     5.0953     5.0630     5.0405     5.0172
util living area
               0.9990     0.9977     0.9937     0.9785     0.9270     0.7951     0.6274     0.6870     0.9038     0.9872     0.9979     0.9993 (86)

MIT          19.6551    19.8032    20.0517    20.3911    20.7031    20.9137    20.9799    20.9687    20.8150    20.4130    19.9772    19.6366 (87)
Th 2         19.9468    19.9497    19.9526    19.9662    19.9687    19.9806    19.9806    19.9828    19.9760    19.9687    19.9636    19.9582 (88)
util rest of house
               0.9987     0.9969     0.9913     0.9694     0.8941     0.7089     0.4961     0.5573     0.8475     0.9803     0.9970     0.9990 (89)
MIT 2        18.1453    18.3638    18.7282    19.2277    19.6595    19.9184    19.9727    19.9688    19.8146    19.2656    18.6283    18.1263 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.1115 (91)
MIT          18.3137    18.5243    18.8759    19.3575    19.7759    20.0294    20.0850    20.0803    19.9262    19.3935    18.7788    18.2947 (92)
Temperature adjustment                                                                                          0.0000
adjusted MIT 18.3137    18.5243    18.8759    19.3575    19.7759    20.0294    20.0850    20.0803    19.9262    19.3935    18.7788    18.2947 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9978     0.9952     0.9877     0.9621     0.8864     0.7136     0.5104     0.5708     0.8440     0.9746     0.9954     0.9984 (94)
Useful gains 670.2035   777.9439   872.4381   947.4120   932.7736   739.1915   505.0377   526.1461   714.5253   726.2681   659.5030   633.5521 (95)
Ext temp.     4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             2142.9591  2076.9009  1880.7863  1566.2314  1206.2065   800.5275   513.8403   541.3293   863.3296  1313.3978  1754.0662  2129.1967 (97)
Month fracti  1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             1095.7302   872.8991   750.2111   445.5499   203.4341     0.0000     0.0000     0.0000     0.0000   436.8245   788.0855  1112.7596 (98)
Space heating                                                                                                   5705.4939 (98)
Space heating per m2                                                                                 (98) / (4) =    43.5268 (99)
```

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6102.1325	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1171.9039	933.5819	802.3648	476.5240	217.5765	0.0000	0.0000	0.0000	0.0000	467.1920	842.8722	1190.1172	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.4330	190.6782	200.0502	179.0489	175.2572	156.3045	149.8338	164.8001	164.6300	185.6772	196.6903	211.1302	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5418	88.3756	88.0155	87.1502	85.2122	79.8000	79.8000	79.8000	79.8000	87.0197	88.1395	88.6053	(217)
Fuel for water heating, kWh/month													
	244.4417	215.7590	227.2897	205.4486	205.6714	195.8703	187.7617	206.5164	206.3032	213.3738	223.1578	238.2817	(219)
Water heating fuel used												2569.8752	(219)
Annual totals kWh/year													
Space heating fuel - main system												6102.1325	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9251.5406	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6102.1325	0.2160	1318.0606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.8752	0.2160	555.0930	(264)
Space and water heating			1873.1537	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/m2/year			2173.9312	(272)
Emissions per m2 for space and water heating			14.2902	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9977	(272b)
Emissions per m2 for pumps and fans			0.2970	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2902 * 1.00) + 1.9977 + 0.2970, rounded to 2 d.p.			16.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		4.2900	
Infiltration rate		0.3325	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3325	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4240	0.4157	0.4074	0.3658	0.3575	0.3159	0.3159	0.3076	0.3325	0.3575	0.3741	0.3907	(22b)
Effective ac	0.5899	0.5864	0.5830	0.5669	0.5639	0.5499	0.5499	0.5473	0.5553	0.5639	0.5700	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19371.7010 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.7853 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.9600	65.5697	65.1871	63.3902	63.0540	61.4890	61.4890	61.1991	62.0918	63.0540	63.7341	64.4452	(38)
Heat transfer coeff	157.4092	157.0189	156.6364	154.8395	154.5033	152.9382	152.9382	152.6484	153.5410	154.5033	155.1834	155.8944	(39)
Average = Sum(39)m / 12 =												154.8378	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2009	1.1979	1.1950	1.1813	1.1787	1.1668	1.1668	1.1645	1.1714	1.1787	1.1839	1.1893	(40)
HLP (average)												1.1812	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8977 (42)
Average daily hot water use (litres/day)		103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	612.9728	741.7759	864.1043	988.5736	1073.0832	1060.7366	1011.7462	929.5794	839.2738	714.6852	610.8988	573.2093	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1850	34.2699	34.3536	34.7523	34.8279	35.1843	35.1843	35.2511	35.0462	34.8279	34.6753	34.5171	
alpha	3.2790	3.2847	3.2902	3.3168	3.3219	3.3456	3.3456	3.3501	3.3364	3.3219	3.3117	3.3011	
util living area													
	0.9935	0.9873	0.9738	0.9395	0.8661	0.7380	0.5965	0.6530	0.8498	0.9612	0.9890	0.9948	(86)
MIT	18.8907	19.1232	19.5045	20.0081	20.4668	20.7935	20.9269	20.8996	20.6355	20.0336	19.3709	18.8537	(87)
Th 2	19.9193	19.9217	19.9240	19.9350	19.9371	19.9467	19.9467	19.9485	19.9430	19.9371	19.9329	19.9286	(88)
util rest of house													
	0.9921	0.9846	0.9677	0.9242	0.8294	0.6617	0.4789	0.5387	0.7943	0.9486	0.9861	0.9937	(89)
MIT 2	17.9867	18.2197	18.5993	19.1004	19.5351	19.8246	19.9179	19.9053	19.7004	19.1338	18.4757	17.9566	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.0875	18.3205	18.7002	19.2017	19.6390	19.9327	20.0305	20.0162	19.8047	19.2341	18.5755	18.0567	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0875	18.3205	18.7002	19.2017	19.6390	19.9327	20.0305	20.0162	19.8047	19.2341	18.5755	18.0567	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9788	0.9584	0.9109	0.8171	0.6605	0.4891	0.5469	0.7855	0.9374	0.9808	0.9908	(94)
Useful gains	605.9772	726.0216	828.1506	900.5134	876.8335	700.6595	494.8634	508.3672	659.2897	669.9336	599.1750	567.9151	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2170.2859	2107.2743	1911.0018	1595.1050	1226.6020	815.5695	524.6492	552.0091	875.9055	1334.0017	1780.8081	2160.1755	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1163.8457	928.2018	805.6413	500.1059	260.2278	0.0000	0.0000	0.0000	0.0000	494.0666	850.7758	1184.6418	(98)
Space heating												6187.5068	(98)
Space heating per m2											(98) / (4) =	47.2040	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1437.6192	1131.7428	1160.1278	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7480	0.8200	0.7849	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1075.3281	928.0766	910.5973	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7259	1299.8139	1206.3007	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	204.7664	276.5726	220.0034	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												701.3424	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	51.1916	69.1431	55.0008	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												175.3356	(107)
Space cooling per m2												1.3376	(108)
Energy for space heating												47.2040	(99)
Energy for space cooling												1.3376	(108)
Total												48.5417	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716 (1b) - (3b)	
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)

Water heating gains (Table 5)

	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)

Total internal gains

	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	589.5269	700.4404	803.8327	907.6680	976.7793	962.6293	918.2006	847.9039	771.9167	667.9991	582.5614	553.3093	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area	0.9995	0.9986	0.9959	0.9846	0.9434	0.8280	0.6667	0.7303	0.9286	0.9920	0.9988	0.9996	(86)
MIT	19.5967	19.7457	19.9964	20.3410	20.6644	20.8945	20.9737	20.9587	20.7802	20.3606	19.9203	19.5786	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house	0.9993	0.9981	0.9942	0.9778	0.9160	0.7464	0.5317	0.5998	0.8819	0.9875	0.9983	0.9995	(89)
MIT 2	18.6585	18.8096	19.0620	19.4139	19.7245	19.9268	19.9732	19.9695	19.8394	19.4378	18.9953	18.6495	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9974	0.9925	0.9739	0.9113	0.7515	0.5466	0.6136	0.8800	0.9848	0.9977	0.9993	(94)
Useful gains	588.9201	698.6159	797.8199	883.9420	890.1389	723.3883	501.8578	520.3121	679.3039	657.8365	581.2303	552.9008	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2211.6843	2136.3065	1924.9108	1590.1618	1214.1851	801.3087	513.8094	541.2617	866.0234	1335.3775	1802.0817	2198.4416	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1207.3366	966.1281	838.5556	508.4783	241.0904	0.0000	0.0000	0.0000	0.0000	504.0905	879.0130	1224.2823	(98)
Space heating												6368.9748	(98)
Space heating per m2											(98) / (4) =	48.5885	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1385.9584	1091.0737	1117.8641	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7886	0.8707	0.8341	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1092.9704	949.9688	932.4168	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1245.0551	1190.4749	1110.8358	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	109.5010	178.9365	132.7438	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												421.1813	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	27.3753	44.7341	33.1859	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												105.2953 (107)
Space cooling per m2												0.8033 (108)
Energy for space heating												48.5885 (99)
Energy for space cooling												0.8033 (108)
Total												49.3917 (109)
Target Fabric Energy Efficiency (TFEE)												56.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.2900	
Infiltration rate		0.3621	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3802	0.3530	0.3621	0.3440	0.3440	0.3349	0.3259	0.3168	0.3078	0.3349	0.3168	0.3349	(22b)
Effective ac	0.5723	0.5623	0.5655	0.5592	0.5592	0.5561	0.5531	0.5502	0.5474	0.5561	0.5502	0.5561	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19371.7010 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.7853 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9891	62.8760	63.2379	62.5233	62.5233	62.1798	61.8454	61.5202	61.2041	62.1798	61.5202	62.1798	(38)
Heat transfer coeff	155.4384	154.3253	154.6872	153.9726	153.9726	153.6290	153.2946	152.9694	152.6534	153.6290	152.9694	153.6290	(39)
Average = Sum(39)m / 12 =												153.7642	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1858	1.1773	1.1801	1.1746	1.1746	1.1720	1.1695	1.1670	1.1646	1.1720	1.1670	1.1720	(40)
HLP (average)												1.1731	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
RHI water heating demand												2161	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	970.3193	1071.5241	1195.5413	1321.1495	1362.9872	1401.6760	1334.7215	1262.1709	1165.2833	1040.9810	956.2519	915.0337	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6184	34.8681	34.7865	34.9480	34.9480	35.0261	35.1025	35.1771	35.2500	35.0261	35.1771	35.0261	
alpha	3.3079	3.3245	3.3191	3.3299	3.3299	3.3351	3.3402	3.3451	3.3500	3.3351	3.3451	3.3351	
util living area													
	0.9729	0.9619	0.9325	0.8668	0.7532	0.5686	0.4305	0.4515	0.6915	0.8819	0.9542	0.9764	(86)
MIT	19.3658	19.5368	19.8965	20.3421	20.7032	20.9172	20.9755	20.9719	20.8355	20.4140	19.8497	19.3534	(87)
Th 2	19.9314	19.9382	19.9360	19.9403	19.9403	19.9424	19.9445	19.9465	19.9484	19.9424	19.9465	19.9424	(88)
util rest of house													
	0.9673	0.9541	0.9183	0.8381	0.6983	0.4811	0.3214	0.3385	0.6114	0.8493	0.9431	0.9715	(89)
MIT 2	17.7846	18.0347	18.5469	19.1697	19.6419	19.8825	19.9336	19.9339	19.8113	19.2823	18.4942	17.7742	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	17.9610	18.2022	18.6974	19.3004	19.7602	19.9979	20.0498	20.0496	19.9256	19.4085	18.6454	17.9503	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8110	18.0522	18.5474	19.1504	19.6102	19.8479	19.8998	19.8996	19.7756	19.2585	18.4954	17.8003	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9512	0.9349	0.8941	0.8120	0.6789	0.4727	0.3166	0.3332	0.5965	0.8227	0.9219	0.9567	(94)
Useful gains	922.9597	1001.8155	1068.8971	1072.7915	925.3054	662.5553	422.5680	420.5766	695.1453	856.4563	881.5970	875.4530	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2006.8586	1967.9896	1786.2335	1485.9003	1094.7831	698.6926	429.1982	428.2579	774.8039	1207.3000	1620.7736	1966.5034	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	806.4208	649.2690	533.6983	297.4383	126.0914	0.0000	0.0000	0.0000	0.0000	261.0277	532.2072	811.7415	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	4017.8942 (98)
RHI space heating demand	4018 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.2900	
Infiltration rate		0.3621	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4616	0.4526	0.4435	0.3983	0.3892	0.3440	0.3440	0.3349	0.3621	0.3892	0.4073	0.4254	(22b)
Effective ac	0.6066	0.6024	0.5984	0.5793	0.5757	0.5592	0.5592	0.5561	0.5655	0.5757	0.5830	0.5905	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.8231	67.3605	66.9070	64.7770	64.3785	62.5233	62.5233	62.1798	63.2379	64.3785	65.1847	66.0275	(38)
Heat transfer coeff	159.2724	158.8097	158.3562	156.2262	155.8277	153.9726	153.9726	153.6290	154.6872	155.8277	156.6339	157.4768	(39)
Average = Sum(39)m / 12 =												156.2243	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2115	1.2081	1.1918	1.1888	1.1746	1.1746	1.1720	1.1801	1.1888	1.1949	1.2014	(40)
HLP (average)												1.1918	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	929.2951	1053.9762	1163.5620	1269.8881	1336.5572	1309.5385	1253.3569	1176.8671	1098.3782	992.0178	907.3315	883.3690	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7851	33.8835	33.9805	34.4438	34.5319	34.9480	34.9480	35.0261	34.7865	34.5319	34.3542	34.1703	
alpha	3.2523	3.2589	3.2654	3.2963	3.3021	3.3299	3.3299	3.3351	3.3191	3.3021	3.2903	3.2780	
util living area													
	0.9785	0.9665	0.9433	0.8920	0.7976	0.6505	0.5061	0.5513	0.7573	0.9127	0.9665	0.9816	(86)
MIT	19.1787	19.3981	19.7506	20.2069	20.5985	20.8595	20.9546	20.9391	20.7527	20.2507	19.6399	19.1428	(87)
Th 2	19.9080	19.9108	19.9135	19.9265	19.9290	19.9403	19.9403	19.9424	19.9360	19.9290	19.9240	19.9189	(88)
util rest of house													
	0.9741	0.9597	0.9314	0.8683	0.7514	0.5707	0.3976	0.4428	0.6883	0.8885	0.9585	0.9778	(89)
MIT 2	17.4992	17.8176	18.3252	18.9758	19.5024	19.8249	19.9158	19.9067	19.7102	19.0508	18.1791	17.4541	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6865	17.9939	18.4841	19.1131	19.6246	19.9403	20.0316	20.0219	19.8265	19.1847	18.3420	17.6424	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5365	17.8439	18.3341	18.9631	19.4746	19.7903	19.8816	19.8719	19.6765	19.0347	18.1920	17.4924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9598	0.9413	0.9080	0.8416	0.7285	0.5582	0.3912	0.4349	0.6687	0.8620	0.9399	0.9649	(94)
Useful gains	891.9517	992.1501	1056.4997	1068.7184	973.7372	730.9789	490.3452	511.8595	734.4393	855.1429	852.8433	852.4067	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2108.2082	2055.6102	1874.0111	1572.1270	1211.5029	799.1589	505.2806	533.3829	862.6136	1314.3525	1737.3839	2093.2483	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	904.8948	714.6452	608.2285	362.4542	176.8977	0.0000	0.0000	0.0000	0.0000	341.6519	636.8692	923.1862	(98)
Space heating												4668.8277	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 35.6182 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5164.6324 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	904.8948	714.6452	608.2285	362.4542	176.8977	0.0000	0.0000	0.0000	0.0000	341.6519	636.8692	923.1862	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1000.9899	790.5367	672.8191	400.9449	195.6833	0.0000	0.0000	0.0000	0.0000	377.9336	704.5014	1021.2236	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1376	87.9369	87.5195	86.5913	84.7769	79.7000	79.7000	79.7000	79.7000	86.3539	87.6497	88.2170	(217)
Fuel for water heating, kWh/month	242.7077	214.2506	225.7026	203.9625	203.7595	193.0607	184.8401	203.6183	203.5067	212.1049	221.6268	236.4781	(219)

Water heating fuel used 2545.6185 (219)
Annual totals kWh/year
Space heating fuel - main system 5164.6324 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 504.5329 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 7071.2267 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5164.6324	3.4800	179.7292	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2545.6185	3.4800	88.5875	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			304.0294	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.7252 (257)
SAP value 89.8835
SAP rating (Section 12) 90 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5164.6324	0.2160	1115.5606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.6185	0.2160	549.8536	(264)
Space and water heating			1665.4142	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1333.7606	(272)
CO2 emissions per m2			10.1800	(273)
EI value			89.8498	
EI rating			90	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8467 = 4.110, stars = 4
Water heating environmental impact	0.216 / 0.8467 = 0.2551, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			4.2900	
Infiltration rate			0.3621	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3802	0.3530	0.3621	0.3440	0.3440	0.3349	0.3259	0.3168	0.3078	0.3349	0.3168	0.3349	(22b)
Effective ac	0.5723	0.5623	0.5655	0.5592	0.5592	0.5561	0.5531	0.5502	0.5474	0.5561	0.5502	0.5561	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9891	62.8760	63.2379	62.5233	62.5233	62.1798	61.8454	61.5202	61.2041	62.1798	61.5202	62.1798	(38)
Heat transfer coeff	155.4384	154.3253	154.6872	153.9726	153.9726	153.6290	153.2946	152.9694	152.6534	153.6290	152.9694	153.6290	(39)
Average = Sum(39)m / 12 =												153.7642	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1858	1.1773	1.1801	1.1746	1.1746	1.1720	1.1695	1.1670	1.1646	1.1720	1.1670	1.1720	(40)
HLP (average)												1.1731	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	970.3193	1071.5241	1195.5413	1321.1495	1362.9872	1401.6760	1334.7215	1262.1709	1165.2833	1040.9810	956.2519	915.0337	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6184	34.8681	34.7865	34.9480	34.9480	35.0261	35.1025	35.1771	35.2500	35.0261	35.1771	35.0261	
alpha	3.3079	3.3245	3.3191	3.3299	3.3299	3.3351	3.3402	3.3451	3.3500	3.3351	3.3451	3.3351	
util living area													
	0.9729	0.9619	0.9325	0.8668	0.7532	0.5686	0.4305	0.4515	0.6915	0.8819	0.9542	0.9764	(86)
MIT	19.3658	19.5368	19.8965	20.3421	20.7032	20.9172	20.9755	20.9719	20.8355	20.4140	19.8497	19.3534	(87)
Th 2	19.9314	19.9382	19.9360	19.9403	19.9403	19.9424	19.9445	19.9465	19.9484	19.9424	19.9465	19.9424	(88)
util rest of house													
	0.9673	0.9541	0.9183	0.8381	0.6983	0.4811	0.3214	0.3385	0.6114	0.8493	0.9431	0.9715	(89)
MIT 2	17.7846	18.0347	18.5469	19.1697	19.6419	19.8825	19.9336	19.9339	19.8113	19.2823	18.4942	17.7742	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9610	18.2022	18.6974	19.3004	19.7602	19.9979	20.0498	20.0496	19.9256	19.4085	18.6454	17.9503	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8110	18.0522	18.5474	19.1504	19.6102	19.8479	19.8998	19.8996	19.7756	19.2585	18.4954	17.8003	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9512	0.9349	0.8941	0.8120	0.6789	0.4727	0.3166	0.3332	0.5965	0.8227	0.9219	0.9567	(94)
Useful gains	922.9597	1001.8155	1068.8971	1072.7915	925.3054	662.5553	422.5680	420.5766	695.1453	856.4563	881.5970	875.4530	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2006.8586	1967.9896	1786.2335	1485.9003	1094.7831	698.6926	429.1982	428.2579	774.8039	1207.3000	1620.7736	1966.5034	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	806.4208	649.2690	533.6983	297.4383	126.0914	0.0000	0.0000	0.0000	0.0000	261.0277	532.2072	811.7415	(98)
Space heating												4017.8942	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 30.6522 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4444.5733 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	806.4208	649.2690	533.6983	297.4383	126.0914	0.0000	0.0000	0.0000	0.0000	261.0277	532.2072	811.7415	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	892.0584	718.2179	590.3742	329.0247	139.4816	0.0000	0.0000	0.0000	0.0000	288.7475	588.7247	897.9442	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.9252	87.7503	87.2362	86.0938	83.8897	79.7000	79.7000	79.7000	79.7000	85.6580	87.2672	87.9850	(217)
Fuel for water heating, kWh/month	243.2939	214.7062	226.4356	205.1411	205.9143	193.0607	184.8401	203.6183	203.5067	213.8281	222.5982	237.1018	(219)
Water heating fuel used												2554.0450	(219)

Annual totals kWh/year	
Space heating fuel - main system	4444.5733 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	504.5329 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =	-1368.9771 -1368.9771 (233)
Total delivered energy for all uses	6209.1740 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4444.5733	10.2300	454.6798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2554.0450	10.2300	261.2788	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	504.5329	36.7200	185.2645	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			529.0747	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4444.5733	0.2160	960.0278	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2554.0450	0.2160	551.6737	(264)
Space and water heating			1511.7015	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			1101.9800	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4444.5733	1.2200	5422.3794	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2554.0450	1.2200	3115.9349	(264)
Space and water heating			8538.3143	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	504.5329	3.0700	1548.9160	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			6114.7205 (272)
Primary energy kWh/m2/year			46.6488 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 120	-265 kg (24.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£120	2.02 kg/m²	B 91	A 92
Total Savings	£120	2.02 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£213	£231	-£18
Mains gas	£819	£681	£138
Space heating	£585	£589	-£3
Water heating	£261	£138	£123
Lighting	£185	£185	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£529	£409	£120
Total cost of uses	£528	£409	£120
Delivered energy	47 kWh/m²	37 kWh/m²	10 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.8 tonnes	0.3 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	47 kWh/m²	35 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.2900	
Infiltration rate		0.3621	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4616	0.4526	0.4435	0.3983	0.3892	0.3440	0.3440	0.3349	0.3621	0.3892	0.4073	0.4254	(22b)
Effective ac	0.6066	0.6024	0.5984	0.5793	0.5757	0.5592	0.5592	0.5561	0.5655	0.5757	0.5830	0.5905	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.8231	67.3605	66.9070	64.7770	64.3785	62.5233	62.5233	62.1798	63.2379	64.3785	65.1847	66.0275	(38)
Heat transfer coeff	159.2724	158.8097	158.3562	156.2262	155.8277	153.9726	153.9726	153.6290	154.6872	155.8277	156.6339	157.4768	(39)
Average = Sum(39)m / 12 =												156.2243	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2115	1.2081	1.1918	1.1888	1.1746	1.1746	1.1720	1.1801	1.1888	1.1949	1.2014	(40)
HLP (average)												1.1918	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977	(42)
Average daily hot water use (litres/day)	103.0212	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1189	(H8)
Utilisation factor												0.5909	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.2780	(H17)
Solar input	-27.3242	-45.5962	-77.6556	-104.0738	-128.5744	-126.4091	-124.7385	-108.9847	-85.3569	-58.2887	-32.4104	-22.8657	(63)
										Solar input (sum of months) = Sum(63)m =		-942.2780	(63)
Output from w/h													
	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
										Total per year (kWh/year) = Sum(64)m =		1060.5180	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	920.8350	1045.5162	1153.6012	1253.9240	1314.3398	1287.0710	1230.8894	1155.4001	1083.9149	982.0569	898.8714	874.9089	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7851	33.8835	33.9805	34.4438	34.5319	34.9480	34.9480	35.0261	34.7865	34.5319	34.3542	34.1703	
alpha	3.2523	3.2589	3.2654	3.2963	3.3021	3.3299	3.3299	3.3351	3.3191	3.3021	3.2903	3.2780	
util living area													
	0.9790	0.9672	0.9445	0.8950	0.8035	0.6580	0.5138	0.5593	0.7625	0.9148	0.9673	0.9820	(86)
MIT	19.1706	19.3904	19.7423	20.1959	20.5882	20.8544	20.9526	20.9364	20.7471	20.2433	19.6321	19.1346	(87)
Th 2	19.9080	19.9108	19.9135	19.9265	19.9290	19.9403	19.9403	19.9424	19.9360	19.9290	19.9240	19.9189	(88)
util rest of house													
	0.9747	0.9606	0.9328	0.8717	0.7580	0.5783	0.4042	0.4500	0.6939	0.8910	0.9595	0.9784	(89)
MIT 2	17.4875	17.8065	18.3135	18.9612	19.4900	19.8202	19.9145	19.9050	19.7044	19.0409	18.1680	17.4422	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6752	17.9832	18.4728	19.0989	19.6125	19.9355	20.0303	20.0200	19.8207	19.1750	18.3313	17.6310	(92)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.5252	17.8332	18.3228	18.9489	19.4625	19.7855	19.8803	19.8700	19.6707	19.0250	18.1813	17.4810	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9607	0.9424	0.9096	0.8450	0.7347	0.5654	0.3976	0.4419	0.6740	0.8645	0.9412	0.9658	(94)
Useful gains	884.6216	985.2737	1049.2845	1059.6138	965.6975	727.6571	489.4066	510.5430	730.5060	849.0283	846.0062	844.9497	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2106.4139	2053.9140	1872.2201	1569.9015	1209.6162	798.4303	505.0755	533.0954	861.7108	1312.8511	1735.7119	2091.4436	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	909.0134	718.1263	612.2641	367.4071	181.4755	0.0000	0.0000	0.0000	0.0000	345.0841	640.5881	927.3914	(98)
Space heating												4701.3501	(98)
Space heating per m2											(98) / (4) =	35.8663	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5200.6085	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	909.0134	718.1263	612.2641	367.4071	181.4755	0.0000	0.0000	0.0000	0.0000	345.0841	640.5881	927.3914	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1005.5458	794.3875	677.2833	406.4238	200.7473	0.0000	0.0000	0.0000	0.0000	381.7302	708.6152	1025.8755	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4489	88.5114	88.5803	88.7710	89.0294	79.7000	79.7000	79.7000	79.7000	87.4537	88.1048	88.4881	(217)
Fuel for water heating, kWh/month	202.0654	153.3167	124.8751	65.5308	26.4007	9.0834	2.1132	41.8254	80.0766	132.1941	175.0537	201.0219	(219)
Water heating fuel used												1213.5570	(219)
Annual totals kWh/year													
Space heating fuel - main system												5200.6085	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												5825.1414	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5200.6085	3.4800	180.9812	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1213.5570	3.4800	42.2318	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			265.5207	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6333	(257)
SAP value		91.1649	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5200.6085	0.2160	1123.3314	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1213.5570	0.2160	262.1283	(264)
Space and water heating			1385.4598	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1079.7562	(272)
CO2 emissions per m2			8.2400	(273)
EI value			91.7829	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.2900	
Infiltration rate		0.3621	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3621	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3802	0.3530	0.3621	0.3440	0.3440	0.3349	0.3259	0.3168	0.3078	0.3349	0.3168	0.3349	(22b)
Effective ac	0.5723	0.5623	0.5655	0.5592	0.5592	0.5561	0.5531	0.5502	0.5474	0.5561	0.5502	0.5561	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9891	62.8760	63.2379	62.5233	62.5233	62.1798	61.8454	61.5202	61.2041	62.1798	61.5202	62.1798	(38)
Heat transfer coeff	155.4384	154.3253	154.6872	153.9726	153.9726	153.6290	153.2946	152.9694	152.6534	153.6290	152.9694	153.6290	(39)
Average = Sum(39)m / 12 =												153.7642	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1858	1.1773	1.1801	1.1746	1.1746	1.1720	1.1695	1.1670	1.1646	1.1720	1.1670	1.1720	(40)
HLP (average)												1.1731	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2522	(H8)
Utilisation factor												0.5500	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-981.6617	(H17)
Solar input	-32.0242	-45.5363	-78.2660	-105.5990	-124.0324	-132.4862	-129.7000	-116.0854	-90.8869	-62.8361	-37.8762	-26.3332	(63)
										Solar input (sum of months) = Sum(63)m =		-981.6617	(63)
Output from w/h													
	174.0246	135.7626	110.0042	56.6471	28.0463	1.1624	0.0000	26.2341	58.2911	111.0613	148.7649	174.4129	(64)
										Total per year (kWh/year) = Sum(64)m =		1024.4115	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	961.8593	1063.0641	1185.5804	1305.1854	1340.7699	1379.2084	1312.2539	1240.7039	1150.8200	1031.0202	947.7918	906.5736	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6184	34.8681	34.7865	34.9480	34.9480	35.0261	35.1025	35.1771	35.2500	35.0261	35.1771	35.0261	
alpha	3.3079	3.3245	3.3191	3.3299	3.3299	3.3351	3.3402	3.3451	3.3500	3.3351	3.3451	3.3351	
util living area													
	0.9735	0.9627	0.9338	0.8701	0.7597	0.5757	0.4370	0.4584	0.6968	0.8843	0.9552	0.9770	(86)
MIT	19.3578	19.5292	19.8884	20.3322	20.6948	20.9140	20.9743	20.9706	20.8315	20.4074	19.8423	19.3453	(87)
Th 2	19.9314	19.9382	19.9360	19.9403	19.9403	19.9424	19.9445	19.9465	19.9484	19.9424	19.9465	19.9424	(88)
util rest of house													
	0.9681	0.9551	0.9199	0.8419	0.7053	0.4878	0.3266	0.3440	0.6169	0.8522	0.9444	0.9722	(89)
MIT 2	17.7732	18.0238	18.5357	19.1567	19.6324	19.8800	19.9331	19.9332	19.8075	19.2739	18.4838	17.7625	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9499	18.1917	18.6866	19.2878	19.7509	19.9953	20.0492	20.0489	19.9217	19.4003	18.6353	17.9391	(92)

Temperature adjustment												-0.1500	
adjusted MIT	17.7999	18.0417	18.5366	19.1378	19.6009	19.8453	19.8992	19.8989	19.7717	19.2503	18.4853	17.7891	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9522	0.9361	0.8958	0.8157	0.6854	0.4791	0.3217	0.3386	0.6017	0.8256	0.9234	0.9577	(94)
Useful gains	915.8570	995.1078	1062.0513	1064.6934	918.9596	660.7110	422.1464	420.0890	692.4935	851.1987	875.1918	868.2171	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2005.1405	1966.3644	1784.5617	1483.9591	1093.3372	698.2965	429.1045	428.1497	774.2165	1206.0333	1619.2249	1964.7727	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	810.4270	652.6844	537.5477	301.8712	129.7369	0.0000	0.0000	0.0000	0.0000	263.9969	535.7039	815.8374	(98)
Space heating												4047.8055	(98)
Space heating per m2											(98) / (4) =	30.8804	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4477.6609	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	810.4270	652.6844	537.5477	301.8712	129.7369	0.0000	0.0000	0.0000	0.0000	263.9969	535.7039	815.8374	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	896.4900	721.9961	594.6325	333.9284	143.5143	0.0000	0.0000	0.0000	0.0000	292.0320	592.5928	902.4750	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	174.0246	135.7626	110.0042	56.6471	28.0463	1.1624	0.0000	26.2341	58.2911	111.0613	148.7649	174.4129	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3043	88.3574	88.3843	88.5222	88.2930	79.7000	79.7000	79.7000	79.7000	86.9436	87.8370	88.3118	(217)
Fuel for water heating, kWh/month	197.0737	153.6516	124.4613	63.9919	31.7651	1.4585	0.0000	32.9161	73.1381	127.7395	169.3648	197.4968	(219)
Water heating fuel used												1173.0573	(219)
Annual totals kWh/year													
Space heating fuel - main system												4477.6609	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4911.2740	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4477.6609	10.2300	458.0647	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1173.0573	10.2300	120.0038	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	504.5329	36.7200	185.2645	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			409.5446	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4477.6609	0.2160	967.1748	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1173.0573	0.2160	253.3804	(264)
Space and water heating			1220.5551	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	504.5329	0.5190	261.8526 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			836.7836 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4477.6609	1.2200	5462.7463 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1173.0573	1.2200	1431.1299 (264)
Space and water heating			6893.8762 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	504.5329	3.0700	1548.9160 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			4623.7825 (272)
Primary energy kWh/m2/year			35.2745 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	447.27 (P1)
Transmission heat loss coefficient	91.45 (37)
Summer heat loss coefficient	538.72 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.6800	98.8453	0.4600	0.0000	0.9000	314.2805
South West	6.9600	119.9223	0.4600	0.0000	0.9000	345.5490
South West	3.8000	119.9223	0.4600	0.0000	0.9000	188.6618
total:						848.4914

	Jun	Jul	Aug	
Solar gains	900	848	755	(P4)
Internal gains	591	568	578	
Total summer gains	1491	1417	1334	(P5)
Summer gain/loss ratio	2.77	2.63	2.48	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.8)	0.97	0.97	0.97	
Threshold temperature	19.73	21.50	21.24	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-328	**Issued on Date**	28/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Richmond-As-DET
Property	28, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.55	**TER**	16.58
Environmental	90 B	**% DER<TER**	30.36		
CO_2 Emissions (t/year)	1.11	**DFEE**	48.79	**TFEE**	56.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.11		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Detached House, total floor area 131 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.55 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.8 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.50 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.68 m², No overhang
Windows facing South West: 10.76 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.026 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1476	(8)
Pressure test				Yes	
Measured/design AP50				4.5000	
Infiltration rate				0.3726	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4750	0.4657	0.4564	0.4098	0.4005	0.3539	0.3539	0.3446	0.3726	0.4005	0.4191	0.4378	(22b)
Effective ac	0.6128	0.6084	0.6041	0.5840	0.5802	0.5626	0.5626	0.5594	0.5694	0.5802	0.5878	0.5958	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5242	68.0343	67.5542	65.2988	64.8769	62.9125	62.9125	62.5488	63.6692	64.8769	65.7305	66.6229	(38)
Heat transfer coeff	159.9734	159.4836	159.0034	156.7481	156.3261	154.3618	154.3618	153.9980	155.1184	156.3261	157.1797	158.0722	(39)
Average = Sum(39)m / 12 =												156.7460	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2204	1.2167	1.2130	1.1958	1.1926	1.1776	1.1776	1.1748	1.1834	1.1926	1.1991	1.2059	(40)
HLP (average)												1.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	521.4710	518.9998	501.5003	473.1227	443.8038	416.0943	398.4746	405.2546	420.1887	448.8016	481.6107	506.7017	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	692.3918	820.3361	940.8809	1062.9255	1145.8610	1131.2978	1080.4234	1000.6706	911.2226	789.1436	688.1910	651.7730	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9722	34.0766	34.1795	34.6713	34.7648	35.2072	35.2072	35.2904	35.0355	34.7648	34.5760	34.3808	
alpha	3.2648	3.2718	3.2786	3.3114	3.3177	3.3471	3.3471	3.3527	3.3357	3.3177	3.3051	3.2921	
util living area													
	0.9910	0.9836	0.9680	0.9296	0.8503	0.7153	0.5717	0.6244	0.8270	0.9511	0.9848	0.9926	(86)
MIT	18.9510	19.1811	19.5578	20.0563	20.5015	20.8135	20.9358	20.9127	20.6699	20.0901	19.4360	18.9191	(87)
Th 2	19.9037	19.9067	19.9096	19.9233	19.9259	19.9379	19.9379	19.9402	19.9333	19.9259	19.9207	19.9153	(88)
util rest of house													
	0.9890	0.9800	0.9606	0.9122	0.8106	0.6368	0.4551	0.5100	0.7667	0.9356	0.9809	0.9910	(89)
MIT 2	17.1657	17.5020	18.0493	18.7697	19.3822	19.7796	19.9020	19.8868	19.6185	18.8303	17.8838	17.1261	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.3648	17.6892	18.2175	18.9132	19.5070	19.8949	20.0173	20.0013	19.7358	18.9708	18.0569	17.3261	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2148	17.5392	18.0675	18.7632	19.3570	19.7449	19.8673	19.8513	19.5858	18.8208	17.9069	17.1761	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9680	0.9425	0.8872	0.7849	0.6205	0.4466	0.4993	0.7424	0.9128	0.9693	0.9842	(94)
Useful gains	679.2963	794.0903	886.7674	943.0379	899.3556	701.9590	482.5498	499.5859	676.4573	720.3692	667.0938	641.4907	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2066.0322	2015.7503	1839.2772	1546.0393	1196.9902	794.1783	504.3402	531.4862	850.9416	1285.1254	1698.6227	2051.1579	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1031.7315	820.9555	708.6673	434.1610	221.4402	0.0000	0.0000	0.0000	0.0000	420.1786	742.7008	1048.7924	(98)
Space heating												5428.6273	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 41.4146 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6005.1187	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1031.7315	820.9555	708.6673	434.1610	221.4402	0.0000	0.0000	0.0000	0.0000	420.1786	742.7008	1048.7924	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1141.2959	908.1366	783.9240	480.2666	244.9560	0.0000	0.0000	0.0000	0.0000	464.7993	821.5717	1160.1686	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3628	88.1900	87.8297	87.0217	85.3770	79.7000	79.7000	79.7000	79.7000	86.8599	87.9519	88.4303	(217)
Fuel for water heating, kWh/month													
	242.0892	213.6358	224.9055	202.9536	202.3273	193.0607	184.8401	203.6183	203.5067	210.8694	220.8651	235.9077	(219)
Water heating fuel used												2538.5793	(219)
Annual totals kWh/year													
Space heating fuel - main system												6005.1187	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												7904.6739	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6005.1187	0.2160	1297.1056	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2538.5793	0.2160	548.3331	(264)
Space and water heating			1845.4388	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1513.7852	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.5500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.5500	ZC1
Total Floor Area	TFA	131.0800	
Assumed number of occupants	N	2.8977	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5178	ZC2
CO2 emissions from cooking, equation (L16)		1.4384	ZC3
Total CO2 emissions		26.5062	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.5062	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)

Water storage loss:	
Store volume	170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5003 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.8102 (55)
Total storage loss
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (56)
If cylinder contains dedicated solar storage
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2190.5335 (64)
Heat gains from water heating, kWh/month
               94.5805    83.8284    89.1333    81.4208    80.8896    73.8582    72.4363    77.4126    76.6265    84.3542    87.2865    92.8174 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868   144.8868 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                28.5687    25.3745    20.6359    15.6227    11.6782     9.8592    10.6532    13.8475    18.5860    23.5992    27.5438    29.3628 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               299.0175   302.1204   294.3013   277.6553   256.6427   236.8939   223.7004   220.5976   228.4167   245.0627   266.0752   285.8241 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887    37.4887 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094  -115.9094 (71)
Water heating gains (Table 5)
               127.1244   124.7446   119.8028   113.0844   108.7226   102.5809    97.3607   104.0492   106.4257   113.3794   121.2313   124.7545 (72)
Total internal gains
               524.1767   521.7055   504.2060   475.8284   446.5095   418.8000   401.1803   407.9603   422.8944   451.5073   484.3164   509.4074 (73)
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6. Solar gains

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[Jan]                                    Area        Solar flux          g              FF           Access          Gains
                                          m2          Table 6a     Specific data  Specific data     factor           W
                                                        W/m2       or Table 6b    or Table 6c     Table 6d
-------------------------------------------------------------------------------------------------------------------------
Northeast                                7.6800         11.2829          0.6300         0.7000         0.7700      26.4823 (75)
Southwest                               10.7600         36.7938          0.6300         0.7000         0.7700     120.9927 (79)
-------------------------------------------------------------------------------------------------------------------------

Solar gains  147.4750   260.0008   379.1091   508.8972   605.7533   617.0962   588.4032   513.7405   423.6768   293.6560   178.2429   125.1713 (83)
Total gains  671.6517   781.7063   883.3151   984.7257  1052.2628  1035.8962   989.5836   921.7007   846.5712   745.1633   662.5593   634.5787 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          59.5268    59.7135    59.8976    60.7779    60.9455    61.7379    61.7379    61.8869    61.4302    60.9455    60.6074    60.2580
alpha         4.9685     4.9809     4.9932     5.0519     5.0630     5.1159     5.1159     5.1258     5.0953     5.0630     5.0405     5.0172
util living area
               0.9990     0.9977     0.9937     0.9785     0.9270     0.7951     0.6274     0.6870     0.9038     0.9872     0.9979     0.9993 (86)

MIT          19.6551    19.8032    20.0517    20.3911    20.7031    20.9137    20.9799    20.9687    20.8150    20.4130    19.9772    19.6366 (87)
Th 2         19.9468    19.9497    19.9526    19.9662    19.9687    19.9806    19.9806    19.9828    19.9760    19.9687    19.9636    19.9582 (88)
util rest of house
               0.9987     0.9969     0.9913     0.9694     0.8941     0.7089     0.4961     0.5573     0.8475     0.9803     0.9970     0.9990 (89)
MIT 2        18.1453    18.3638    18.7282    19.2277    19.6595    19.9184    19.9727    19.9688    19.8146    19.2656    18.6283    18.1263 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.1115 (91)
MIT          18.3137    18.5243    18.8759    19.3575    19.7759    20.0294    20.0850    20.0803    19.9262    19.3935    18.7788    18.2947 (92)
Temperature adjustment                                                                                          0.0000
adjusted MIT 18.3137    18.5243    18.8759    19.3575    19.7759    20.0294    20.0850    20.0803    19.9262    19.3935    18.7788    18.2947 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9978     0.9952     0.9877     0.9621     0.8864     0.7136     0.5104     0.5708     0.8440     0.9746     0.9954     0.9984 (94)
Useful gains 670.2035   777.9439   872.4381   947.4120   932.7736   739.1915   505.0377   526.1461   714.5253   726.2681   659.5030   633.5521 (95)
Ext temp.     4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             2142.9591  2076.9009  1880.7863  1566.2314  1206.2065   800.5275   513.8403   541.3293   863.3296  1313.3978  1754.0662  2129.1967 (97)
Month fracti  1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             1095.7302   872.8991   750.2111   445.5499   203.4341     0.0000     0.0000     0.0000     0.0000   436.8245   788.0855  1112.7596 (98)
Space heating                                                                                                   5705.4939 (98)
Space heating per m2                                                                                 (98) / (4) =    43.5268 (99)
```

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6102.1325	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1171.9039	933.5819	802.3648	476.5240	217.5765	0.0000	0.0000	0.0000	0.0000	467.1920	842.8722	1190.1172	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.4330	190.6782	200.0502	179.0489	175.2572	156.3045	149.8338	164.8001	164.6300	185.6772	196.6903	211.1302	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5418	88.3756	88.0155	87.1502	85.2122	79.8000	79.8000	79.8000	79.8000	87.0197	88.1395	88.6053	(217)
Fuel for water heating, kWh/month													
	244.4417	215.7590	227.2897	205.4486	205.6714	195.8703	187.7617	206.5164	206.3032	213.3738	223.1578	238.2817	(219)
Water heating fuel used												2569.8752	(219)
Annual totals kWh/year													
Space heating fuel - main system												6102.1325	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9251.5406	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6102.1325	0.2160	1318.0606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.8752	0.2160	555.0930	(264)
Space and water heating			1873.1537	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/m2/year			2173.9312	(272)
Emissions per m2 for space and water heating			14.2902	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9977	(272b)
Emissions per m2 for pumps and fans			0.2970	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2902 * 1.00) + 1.9977 + 0.2970, rounded to 2 d.p.			16.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3430	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3430	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4374	0.4288	0.4202	0.3774	0.3688	0.3259	0.3259	0.3173	0.3430	0.3688	0.3859	0.4031	(22b)
Effective ac	0.5957	0.5919	0.5883	0.5712	0.5680	0.5531	0.5531	0.5503	0.5588	0.5680	0.5745	0.5812	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	66.6047	66.1894	65.7823	63.8701	63.5123	61.8469	61.8469	61.5385	62.4884	63.5123	64.2361	64.9927	(38)
Heat transfer coeff	158.0540	157.6386	157.2315	155.3193	154.9616	153.2961	153.2961	152.9877	153.9377	154.9616	155.6853	156.4420	(39)
Average = Sum(39)m / 12 =												155.3176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2058	1.2026	1.1995	1.1849	1.1822	1.1695	1.1695	1.1671	1.1744	1.1822	1.1877	1.1935	(40)
HLP (average)												1.1849	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977	(42)
Average daily hot water use (litres/day)	103.0212	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	612.9728	741.7759	864.1043	988.5736	1073.0832	1060.7366	1011.7462	929.5794	839.2738	714.6852	610.8988	573.2093	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3848	34.4754	34.5647	34.9902	35.0710	35.4520	35.4520	35.5235	35.3042	35.0710	34.9079	34.7391	
alpha	3.2923	3.2984	3.3043	3.3327	3.3381	3.3635	3.3635	3.3682	3.3536	3.3381	3.3272	3.3159	
util living area													
	0.9937	0.9877	0.9744	0.9406	0.8678	0.7399	0.5982	0.6547	0.8515	0.9620	0.9893	0.9950	(86)
MIT	18.8966	19.1282	19.5080	20.0109	20.4684	20.7947	20.9275	20.9004	20.6370	20.0367	19.3765	18.8611	(87)
Th 2	19.9154	19.9179	19.9204	19.9321	19.9343	19.9445	19.9445	19.9464	19.9406	19.9343	19.9298	19.9252	(88)
util rest of house													
	0.9923	0.9850	0.9684	0.9255	0.8311	0.6633	0.4800	0.5399	0.7961	0.9495	0.9864	0.9939	(89)
MIT 2	17.9887	18.2208	18.5991	19.1002	19.5338	19.8234	19.9161	19.9038	19.6993	19.1339	18.4780	17.9605	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.0899	18.3220	18.7005	19.2018	19.6381	19.9318	20.0289	20.0149	19.8039	19.2346	18.5782	18.0609	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0899	18.3220	18.7005	19.2018	19.6381	19.9318	20.0289	20.0149	19.8039	19.2346	18.5782	18.0609	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9889	0.9793	0.9593	0.9123	0.8190	0.6622	0.4903	0.5482	0.7874	0.9385	0.9813	0.9910	(94)
Useful gains	606.1795	726.4233	828.9174	901.9033	878.8343	702.4567	496.0279	509.5813	660.8274	670.7474	599.4830	568.0768	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2179.5525	2115.8295	1918.3001	1600.0621	1230.0980	817.3401	525.6442	553.0405	878.0402	1338.0240	1786.9830	2168.4288	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1170.5895	933.6810	810.5007	502.6743	261.3403	0.0000	0.0000	0.0000	0.0000	496.4537	855.0000	1190.6619	(98)
Space heating												6220.9014	(98)
Space heating per m2											(98) / (4) =	47.4588	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1440.9838	1134.3915	1162.7068	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7480	0.8202	0.7851	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1077.8046	930.4620	912.7872	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7259	1299.8139	1206.3007	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	202.9834	274.7978	218.3741	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												696.1552	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	50.7458	68.6994	54.5935	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												174.0388	(107)
Space cooling per m2												1.3277	(108)
Energy for space heating												47.4588	(99)
Energy for space cooling												1.3277	(108)
Total												48.7865	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716 (1b) - (3b)	
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)

Water heating gains (Table 5)

	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)

Total internal gains

	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	589.5269	700.4404	803.8327	907.6680	976.7793	962.6293	918.2006	847.9039	771.9167	667.9991	582.5614	553.3093	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area	0.9995	0.9986	0.9959	0.9846	0.9434	0.8280	0.6667	0.7303	0.9286	0.9920	0.9988	0.9996	(86)
MIT	19.5967	19.7457	19.9964	20.3410	20.6644	20.8945	20.9737	20.9587	20.7802	20.3606	19.9203	19.5786	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house	0.9993	0.9981	0.9942	0.9778	0.9160	0.7464	0.5317	0.5998	0.8819	0.9875	0.9983	0.9995	(89)
MIT 2	18.6585	18.8096	19.0620	19.4139	19.7245	19.9268	19.9732	19.9695	19.8394	19.4378	18.9953	18.6495	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9974	0.9925	0.9739	0.9113	0.7515	0.5466	0.6136	0.8800	0.9848	0.9977	0.9993	(94)
Useful gains	588.9201	698.6159	797.8199	883.9420	890.1389	723.3883	501.8578	520.3121	679.3039	657.8365	581.2303	552.9008	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2211.6843	2136.3065	1924.9108	1590.1618	1214.1851	801.3087	513.8094	541.2617	866.0234	1335.3775	1802.0817	2198.4416	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1207.3366	966.1281	838.5556	508.4783	241.0904	0.0000	0.0000	0.0000	0.0000	504.0905	879.0130	1224.2823	(98)
Space heating												6368.9748	(98)
Space heating per m2											(98) / (4) =	48.5885	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1385.9584	1091.0737	1117.8641	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7886	0.8707	0.8341	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1092.9704	949.9688	932.4168	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1245.0551	1190.4749	1110.8358	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	109.5010	178.9365	132.7438	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												421.1813	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	27.3753	44.7341	33.1859	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												105.2953 (107)
Space cooling per m2												0.8033 (108)
Energy for space heating												48.5885 (99)
Energy for space cooling												0.8033 (108)
Total												49.3917 (109)
Target Fabric Energy Efficiency (TFEE)												56.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							5 * 10 =		50.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3726	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3912	0.3632	0.3726	0.3539	0.3539	0.3446	0.3353	0.3260	0.3167	0.3446	0.3260	0.3446	(22b)
Effective ac	0.5765	0.5660	0.5694	0.5626	0.5626	0.5594	0.5562	0.5531	0.5501	0.5594	0.5531	0.5594	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.4646	63.2860	63.6692	62.9125	62.9125	62.5488	62.1947	61.8504	61.5157	62.5488	61.8504	62.5488	(38)
Heat transfer coeff	155.9138	154.7352	155.1184	154.3618	154.3618	153.9980	153.6440	153.2996	152.9649	153.9980	153.2996	153.9980	(39)
Average = Sum(39)m / 12 =												154.1411	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1895	1.1805	1.1834	1.1776	1.1776	1.1748	1.1721	1.1695	1.1670	1.1748	1.1695	1.1748	(40)
HLP (average)												1.1759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
RHI water heating demand												2161	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	970.3193	1071.5241	1195.5413	1321.1495	1362.9872	1401.6760	1334.7215	1262.1709	1165.2833	1040.9810	956.2519	915.0337	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8568	35.1223	35.0355	35.2072	35.2072	35.2904	35.3717	35.4512	35.5288	35.2904	35.4512	35.2904	
alpha	3.3238	3.3415	3.3357	3.3471	3.3471	3.3527	3.3581	3.3634	3.3686	3.3527	3.3634	3.3527	
util living area													
	0.9735	0.9627	0.9336	0.8684	0.7551	0.5702	0.4316	0.4527	0.6932	0.8834	0.9550	0.9770	(86)
MIT	19.3711	19.5422	19.9001	20.3447	20.7047	20.9179	20.9758	20.9723	20.8368	20.4164	19.8547	19.3602	(87)
Th 2	19.9284	19.9357	19.9333	19.9379	19.9379	19.9402	19.9424	19.9445	19.9465	19.9402	19.9445	19.9402	(88)
util rest of house													
	0.9680	0.9550	0.9196	0.8397	0.7001	0.4822	0.3220	0.3391	0.6128	0.8509	0.9441	0.9721	(89)
MIT 2	17.7891	18.0395	18.5493	19.1708	19.6415	19.8810	19.9317	19.9321	19.8109	19.2833	18.4989	17.7813	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	17.9656	18.2071	18.6999	19.3018	19.7601	19.9967	20.0482	20.0481	19.9253	19.4097	18.6501	17.9574	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8156	18.0571	18.5499	19.1518	19.6101	19.8467	19.8982	19.8981	19.7753	19.2597	18.5001	17.8074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9522	0.9361	0.8956	0.8139	0.6807	0.4739	0.3172	0.3338	0.5980	0.8246	0.9232	0.9577	(94)
Useful gains	923.9387	1003.1026	1070.7582	1075.2662	927.8254	664.2351	423.3828	421.3722	696.8962	858.3528	882.8543	876.3059	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2013.7159	1973.9771	1791.6080	1489.8640	1097.5270	700.1824	429.9213	428.9494	776.3453	1210.3756	1624.9929	1972.3109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	810.7943	652.4276	536.3123	298.5104	126.2579	0.0000	0.0000	0.0000	0.0000	261.9050	534.3398	815.4277	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	4035.9751 (98)
RHI space heating demand	4036 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3726	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4750	0.4657	0.4564	0.4098	0.4005	0.3539	0.3539	0.3446	0.3726	0.4005	0.4191	0.4378	(22b)
Effective ac	0.6128	0.6084	0.6041	0.5840	0.5802	0.5626	0.5626	0.5594	0.5694	0.5802	0.5878	0.5958	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5242	68.0343	67.5542	65.2988	64.8769	62.9125	62.9125	62.5488	63.6692	64.8769	65.7305	66.6229	(38)
Heat transfer coeff	159.9734	159.4836	159.0034	156.7481	156.3261	154.3618	154.3618	153.9980	155.1184	156.3261	157.1797	158.0722	(39)
Average = Sum(39)m / 12 =												156.7460	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2204	1.2167	1.2130	1.1958	1.1926	1.1776	1.1776	1.1748	1.1834	1.1926	1.1991	1.2059	(40)
HLP (average)												1.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	929.2951	1053.9762	1163.5620	1269.8881	1336.5572	1309.5385	1253.3569	1176.8671	1098.3782	992.0178	907.3315	883.3690	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9722	34.0766	34.1795	34.6713	34.7648	35.2072	35.2072	35.2904	35.0355	34.7648	34.5760	34.3808	
alpha	3.2648	3.2718	3.2786	3.3114	3.3177	3.3471	3.3471	3.3527	3.3357	3.3177	3.3051	3.2921	
util living area													
	0.9790	0.9673	0.9444	0.8936	0.7996	0.6523	0.5076	0.5529	0.7593	0.9141	0.9672	0.9820	(86)
MIT	19.1819	19.4007	19.7523	20.2086	20.5996	20.8604	20.9551	20.9397	20.7537	20.2526	19.6434	19.1476	(87)
Th 2	19.9037	19.9067	19.9096	19.9233	19.9259	19.9379	19.9379	19.9402	19.9333	19.9259	19.9207	19.9153	(88)
util rest of house													
	0.9747	0.9606	0.9326	0.8699	0.7533	0.5721	0.3985	0.4437	0.6900	0.8901	0.9594	0.9783	(89)
MIT 2	17.4998	17.8174	18.3239	18.9753	19.5010	19.8236	19.9138	19.9050	19.7091	19.0505	18.1808	17.4574	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6874	17.9940	18.4832	19.1128	19.6236	19.9393	20.0299	20.0204	19.8256	19.1846	18.3439	17.6459	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5374	17.8440	18.3332	18.9628	19.4736	19.7893	19.8799	19.8704	19.6756	19.0346	18.1939	17.4959	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9607	0.9425	0.9095	0.8435	0.7306	0.5597	0.3921	0.4360	0.6705	0.8638	0.9411	0.9658	(94)
Useful gains	892.7713	993.3538	1058.2413	1071.0950	976.4601	732.9709	491.4846	513.0681	736.4796	856.8831	853.8866	853.1167	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2117.6332	2064.3510	1881.5199	1577.3311	1215.2130	801.0250	506.2938	534.4380	864.8733	1318.5465	1743.7339	2101.7116	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	911.2972	719.7101	612.5193	364.4899	177.6322	0.0000	0.0000	0.0000	0.0000	343.4776	640.6900	928.9547	(98)
Space heating												4698.7709	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 35.8466 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5197.7555 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	911.2972	719.7101	612.5193	364.4899	177.6322	0.0000	0.0000	0.0000	0.0000	343.4776	640.6900	928.9547	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1008.0721	796.1394	677.5656	403.1968	196.4958	0.0000	0.0000	0.0000	0.0000	379.9531	708.7279	1027.6047	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1501	87.9503	87.5343	86.6050	84.7879	79.7000	79.7000	79.7000	79.7000	86.3673	87.6619	88.2278	(217)
Fuel for water heating, kWh/month	242.6731	214.2181	225.6645	203.9302	203.7329	193.0607	184.8401	203.6183	203.5067	212.0720	221.5959	236.4492	(219)
Water heating fuel used												2545.3616	(219)

Annual totals kWh/year
Space heating fuel - main system 5197.7555 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 504.5329 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 7104.0929 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5197.7555	3.4800	180.8819	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2545.3616	3.4800	88.5786	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			305.1732	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.7279 (257)
SAP value 89.8455
SAP rating (Section 12) 90 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5197.7555	0.2160	1122.7152	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.3616	0.2160	549.7981	(264)
Space and water heating			1672.5133	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1340.8597	(272)
CO2 emissions per m2			10.2300	(273)
EI value			89.7958	
EI rating			90	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8467 = 4.110, stars = 4
Water heating environmental impact	0.216 / 0.8467 = 0.2551, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3726	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3912	0.3632	0.3726	0.3539	0.3539	0.3446	0.3353	0.3260	0.3167	0.3446	0.3260	0.3446	(22b)
Effective ac	0.5765	0.5660	0.5694	0.5626	0.5626	0.5594	0.5562	0.5531	0.5501	0.5594	0.5531	0.5594	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.4646	63.2860	63.6692	62.9125	62.9125	62.5488	62.1947	61.8504	61.5157	62.5488	61.8504	62.5488	(38)
Heat transfer coeff	155.9138	154.7352	155.1184	154.3618	154.3618	153.9980	153.6440	153.2996	152.9649	153.9980	153.2996	153.9980	(39)
Average = Sum(39)m / 12 =												154.1411	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1895	1.1805	1.1834	1.1776	1.1776	1.1748	1.1721	1.1695	1.1670	1.1748	1.1695	1.1748	(40)
HLP (average)												1.1759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	970.3193	1071.5241	1195.5413	1321.1495	1362.9872	1401.6760	1334.7215	1262.1709	1165.2833	1040.9810	956.2519	915.0337	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8568	35.1223	35.0355	35.2072	35.2072	35.2904	35.3717	35.4512	35.5288	35.2904	35.4512	35.2904	
alpha	3.3238	3.3415	3.3357	3.3471	3.3471	3.3527	3.3581	3.3634	3.3686	3.3527	3.3634	3.3527	
util living area													
	0.9735	0.9627	0.9336	0.8684	0.7551	0.5702	0.4316	0.4527	0.6932	0.8834	0.9550	0.9770	(86)
MIT	19.3711	19.5422	19.9001	20.3447	20.7047	20.9179	20.9758	20.9723	20.8368	20.4164	19.8547	19.3602	(87)
Th 2	19.9284	19.9357	19.9333	19.9379	19.9379	19.9402	19.9424	19.9445	19.9465	19.9402	19.9445	19.9402	(88)
util rest of house													
	0.9680	0.9550	0.9196	0.8397	0.7001	0.4822	0.3220	0.3391	0.6128	0.8509	0.9441	0.9721	(89)
MIT 2	17.7891	18.0395	18.5493	19.1708	19.6415	19.8810	19.9317	19.9321	19.8109	19.2833	18.4989	17.7813	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9656	18.2071	18.6999	19.3018	19.7601	19.9967	20.0482	20.0481	19.9253	19.4097	18.6501	17.9574	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8156	18.0571	18.5499	19.1518	19.6101	19.8467	19.8982	19.8981	19.7753	19.2597	18.5001	17.8074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9522	0.9361	0.8956	0.8139	0.6807	0.4739	0.3172	0.3338	0.5980	0.8246	0.9232	0.9577	(94)
Useful gains	923.9387	1003.1026	1070.7582	1075.2662	927.8254	664.2351	423.3828	421.3722	696.8962	858.3528	882.8543	876.3059	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2013.7159	1973.9771	1791.6080	1489.8640	1097.5270	700.1824	429.9213	428.9494	776.3453	1210.3756	1624.9929	1972.3109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	810.7943	652.4276	536.3123	298.5104	126.2579	0.0000	0.0000	0.0000	0.0000	261.9050	534.3398	815.4277	(98)
Space heating												4035.9751	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 30.7902 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4464.5742 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	810.7943	652.4276	536.3123	298.5104	126.2579	0.0000	0.0000	0.0000	0.0000	261.9050	534.3398	815.4277	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	896.8963	721.7120	593.2658	330.2106	139.6659	0.0000	0.0000	0.0000	0.0000	289.7179	591.0839	902.0218	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.9355	87.7600	87.2471	86.1030	83.8931	79.7000	79.7000	79.7000	79.7000	85.6669	87.2760	87.9934	(217)
Fuel for water heating, kWh/month	243.2655	214.6826	226.4074	205.1190	205.9061	193.0607	184.8401	203.6183	203.5067	213.8060	222.5756	237.0790	(219)
Water heating fuel used												2553.8669	(219)

Annual totals kWh/year
Space heating fuel - main system 4464.5742 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 504.5329 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771 -1368.9771 (233)
Total delivered energy for all uses 6228.9969 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4464.5742	10.2300	456.7259	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2553.8669	10.2300	261.2606	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	504.5329	36.7200	185.2645	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			531.1026	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4464.5742	0.2160	964.3480	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2553.8669	0.2160	551.6352	(264)
Space and water heating			1515.9833	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			1106.2617	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4464.5742	1.2200	5446.7805	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2553.8669	1.2200	3115.7176	(264)
Space and water heating			8562.4981	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	504.5329	3.0700	1548.9160	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			6138.9044 (272)
Primary energy kWh/m2/year			46.8333 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 120	-265 kg (24.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£120	2.02 kg/m²	B 91	A 92
Total Savings	£120	2.02 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£213	£231	-£18
Mains gas	£821	£683	£138
Space heating	£587	£591	-£3
Water heating	£261	£138	£123
Lighting	£185	£185	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£531	£411	£120
Total cost of uses	£530	£411	£120
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.8 tonnes	0.3 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	47 kWh/m²	35 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			4.5000	
Infiltration rate			0.3726	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4750	0.4657	0.4564	0.4098	0.4005	0.3539	0.3539	0.3446	0.3726	0.4005	0.4191	0.4378	(22b)
Effective ac	0.6128	0.6084	0.6041	0.5840	0.5802	0.5626	0.5626	0.5594	0.5694	0.5802	0.5878	0.5958	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5242	68.0343	67.5542	65.2988	64.8769	62.9125	62.9125	62.5488	63.6692	64.8769	65.7305	66.6229	(38)
Heat transfer coeff	159.9734	159.4836	159.0034	156.7481	156.3261	154.3618	154.3618	153.9980	155.1184	156.3261	157.1797	158.0722	(39)
Average = Sum(39)m / 12 =												156.7460	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2204	1.2167	1.2130	1.1958	1.1926	1.1776	1.1776	1.1748	1.1834	1.1926	1.1991	1.2059	(40)
HLP (average)												1.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1189	(H8)
Utilisation factor												0.5909	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.2780	(H17)
Solar input	-27.3242	-45.5962	-77.6556	-104.0738	-128.5744	-126.4091	-124.7385	-108.9847	-85.3569	-58.2887	-32.4104	-22.8657	(63)
										Solar input (sum of months) = Sum(63)m =		-942.2780	(63)
Output from w/h													
	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
										Total per year (kWh/year) = Sum(64)m =		1060.5180	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	920.8350	1045.5162	1153.6012	1253.9240	1314.3398	1287.0710	1230.8894	1155.4001	1083.9149	982.0569	898.8714	874.9089	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9722	34.0766	34.1795	34.6713	34.7648	35.2072	35.2072	35.2904	35.0355	34.7648	34.5760	34.3808	
alpha	3.2648	3.2718	3.2786	3.3114	3.3177	3.3471	3.3471	3.3527	3.3357	3.3177	3.3051	3.2921	
util living area													
	0.9795	0.9680	0.9456	0.8965	0.8055	0.6599	0.5152	0.5609	0.7645	0.9161	0.9680	0.9825	(86)
MIT	19.1738	19.3930	19.7440	20.1976	20.5893	20.8553	20.9530	20.9370	20.7481	20.2452	19.6357	19.1395	(87)
Th 2	19.9037	19.9067	19.9096	19.9233	19.9259	19.9379	19.9379	19.9402	19.9333	19.9259	19.9207	19.9153	(88)
util rest of house													
	0.9753	0.9614	0.9340	0.8733	0.7599	0.5797	0.4051	0.4510	0.6957	0.8925	0.9603	0.9789	(89)
MIT 2	17.4882	17.8064	18.3123	18.9607	19.4887	19.8190	19.9125	19.9033	19.7032	19.0406	18.1698	17.4456	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6762	17.9833	18.4719	19.0986	19.6115	19.9346	20.0286	20.0186	19.8197	19.1750	18.3333	17.6345	(92)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.5262	17.8333	18.3219	18.9486	19.4615	19.7846	19.8786	19.8686	19.6697	19.0250	18.1833	17.4845	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9615	0.9435	0.9111	0.8469	0.7368	0.5669	0.3985	0.4429	0.6758	0.8663	0.9423	0.9665	(94)
Useful gains	885.4214	986.4538	1050.9943	1061.9421	968.3742	729.6416	490.5494	511.7547	732.5282	850.7384	847.0263	845.6413	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2115.8419	2062.6565	1879.7288	1575.1038	1213.3233	800.2981	506.0901	534.1523	863.9704	1317.0448	1742.0646	2099.9112	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	915.4329	723.2082	616.5785	369.4764	182.2422	0.0000	0.0000	0.0000	0.0000	346.9320	644.4276	933.1768	(98)
Space heating												4731.4746	(98)
Space heating per m2											(98) / (4) =	36.0961	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5233.9320	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	915.4329	723.2082	616.5785	369.4764	182.2422	0.0000	0.0000	0.0000	0.0000	346.9320	644.4276	933.1768	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1012.6470	800.0091	682.0558	408.7128	201.5953	0.0000	0.0000	0.0000	0.0000	383.7744	712.8624	1032.2753	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4601	88.5223	88.5908	88.7787	89.0345	79.7000	79.7000	79.7000	79.7000	87.4651	88.1155	88.4978	(217)
Fuel for water heating, kWh/month													
	202.0398	153.2977	124.8602	65.5251	26.3992	9.0834	2.1132	41.8254	80.0766	132.1769	175.0324	200.9997	(219)
Water heating fuel used												1213.4296	(219)
Annual totals kWh/year													
Space heating fuel - main system												5233.9320	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												5858.3375	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5233.9320	3.4800	182.1408	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1213.4296	3.4800	42.2274	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			266.6759	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6361	(257)
SAP value		91.1265	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5233.9320	0.2160	1130.5293	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1213.4296	0.2160	262.1008	(264)
Space and water heating			1392.6301	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1086.9266	(272)
CO2 emissions per m2			8.2900	(273)
EI value			91.7283	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		4.5000	
Infiltration rate		0.3726	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3726	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3912	0.3632	0.3726	0.3539	0.3539	0.3446	0.3353	0.3260	0.3167	0.3446	0.3260	0.3446	(22b)
Effective ac	0.5765	0.5660	0.5694	0.5626	0.5626	0.5594	0.5562	0.5531	0.5501	0.5594	0.5531	0.5594	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.4646	63.2860	63.6692	62.9125	62.9125	62.5488	62.1947	61.8504	61.5157	62.5488	61.8504	62.5488	(38)
Heat transfer coeff	155.9138	154.7352	155.1184	154.3618	154.3618	153.9980	153.6440	153.2996	152.9649	153.9980	153.2996	153.9980	(39)
Average = Sum(39)m / 12 =												154.1411	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1895	1.1805	1.1834	1.1776	1.1776	1.1748	1.1721	1.1695	1.1670	1.1748	1.1695	1.1748	(40)
HLP (average)												1.1759	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2522	(H8)
Utilisation factor												0.5500	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-981.6617	(H17)
Solar input	-32.0242	-45.5363	-78.2660	-105.5990	-124.0324	-132.4862	-129.7000	-116.0854	-90.8869	-62.8361	-37.8762	-26.3332	(63)
										Solar input (sum of months) = Sum(63)m =		-981.6617	(63)
Output from w/h													
	174.0246	135.7626	110.0042	56.6471	28.0463	1.1624	0.0000	26.2341	58.2911	111.0613	148.7649	174.4129	(64)
										Total per year (kWh/year) = Sum(64)m =		1024.4115	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	14.6176	0.4600	0.0000	0.7700	39.7637	(75)
Southwest	6.9600	45.1778	0.4600	0.0000	0.7700	111.3738	(79)
Southwest	3.8000	45.1778	0.4600	0.0000	0.7700	60.8075	(79)

Solar gains	211.9451	318.8841	471.3599	641.0642	728.4872	807.3409	763.3134	680.7198	557.9390	389.3052	255.5008	176.7360	(83)
Total gains	961.8593	1063.0641	1185.5804	1305.1854	1340.7699	1379.2084	1312.2539	1240.7039	1150.8200	1031.0202	947.7918	906.5736	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8568	35.1223	35.0355	35.2072	35.2072	35.2904	35.3717	35.4512	35.5288	35.2904	35.4512	35.2904	
alpha	3.3238	3.3415	3.3357	3.3471	3.3471	3.3527	3.3581	3.3634	3.3686	3.3527	3.3634	3.3527	
util living area													
	0.9742	0.9635	0.9350	0.8717	0.7616	0.5773	0.4382	0.4595	0.6985	0.8858	0.9561	0.9776	(86)
MIT	19.3632	19.5345	19.8921	20.3348	20.6963	20.9148	20.9747	20.9710	20.8328	20.4098	19.8473	19.3521	(87)
Th 2	19.9284	19.9357	19.9333	19.9379	19.9379	19.9402	19.9424	19.9445	19.9465	19.9402	19.9445	19.9402	(88)
util rest of house													
	0.9688	0.9560	0.9212	0.8435	0.7071	0.4889	0.3272	0.3446	0.6183	0.8538	0.9454	0.9728	(89)
MIT 2	17.7777	18.0287	18.5382	19.1579	19.6320	19.8786	19.9312	19.9315	19.8071	19.2749	18.4885	17.7697	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9546	18.1966	18.6892	19.2892	19.7507	19.9941	20.0476	20.0474	19.9215	19.4015	18.6400	17.9462	(92)

Temperature adjustment												-0.1500	
adjusted MIT	17.8046	18.0466	18.5392	19.1392	19.6007	19.8441	19.8976	19.8974	19.7715	19.2515	18.4900	17.7962	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9532	0.9373	0.8974	0.8176	0.6873	0.4803	0.3223	0.3392	0.6033	0.8274	0.9247	0.9586	(94)
Useful gains	916.8147	996.3717	1063.8826	1067.1277	921.4515	662.3919	422.9649	420.8887	694.2394	853.0700	876.4255	869.0501	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2012.0019	1972.3553	1789.9377	1487.9228	1096.0815	699.7883	429.8287	428.8424	775.7597	1209.1094	1623.4477	1970.5856	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	814.8193	655.8610	540.1850	302.9725	129.9247	0.0000	0.0000	0.0000	0.0000	264.8933	537.8560	819.5424	(98)
Space heating												4066.0542	(98)
Space heating per m2											(98) / (4) =	31.0196	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4497.8475	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	814.8193	655.8610	540.1850	302.9725	129.9247	0.0000	0.0000	0.0000	0.0000	264.8933	537.8560	819.5424	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	901.3488	725.5100	597.5498	335.1466	143.7220	0.0000	0.0000	0.0000	0.0000	293.0236	594.9734	906.5735	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	174.0246	135.7626	110.0042	56.6471	28.0463	1.1624	0.0000	26.2341	58.2911	111.0613	148.7649	174.4129	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3134	88.3654	88.3923	88.5279	88.2954	79.7000	79.7000	79.7000	79.7000	86.9515	87.8448	88.3194	(217)
Fuel for water heating, kWh/month	197.0534	153.6377	124.4501	63.9878	31.7642	1.4585	0.0000	32.9161	73.1381	127.7278	169.3497	197.4798	(219)
Water heating fuel used												1172.9632	(219)

Annual totals kWh/year		
Space heating fuel - main system	4497.8475	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =	-1368.9771	-1368.9771 (233)
Total delivered energy for all uses	4931.3665	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4497.8475	10.2300	460.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1172.9632	10.2300	119.9941	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	504.5329	36.7200	185.2645	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			411.6000	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4497.8475	0.2160	971.5351	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1172.9632	0.2160	253.3600	(264)
Space and water heating			1224.8951	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	504.5329	0.5190	261.8526 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			841.1236 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4497.8475	1.2200	5487.3740 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1172.9632	1.2200	1431.0150 (264)
Space and water heating			6918.3890 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	504.5329	3.0700	1548.9160 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			4648.2953 (272)
Primary energy kWh/m2/year			35.4615 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	149.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	447.27 (P1)
Transmission heat loss coefficient	91.45 (37)
Summer heat loss coefficient	538.72 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.6800	98.8453	0.4600	0.0000	0.9000	314.2805
South West	6.9600	119.9223	0.4600	0.0000	0.9000	345.5490
South West	3.8000	119.9223	0.4600	0.0000	0.9000	188.6618
total:						848.4914

	Jun	Jul	Aug	
Solar gains	900	848	755	(P4)
Internal gains	591	568	578	
Total summer gains	1491	1417	1334	(P5)
Summer gain/loss ratio	2.77	2.63	2.48	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.3)	0.96	0.96	0.96	
Threshold temperature	19.72	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-329	**Issued on Date**	06/07/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-As-DET
Property	27, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.48	**TER**	18.80
Environmental	91 B	**% DER<TER**	38.92		
CO_2 Emissions (t/year)	0.78	**DFEE**	52.31	**TFEE**	59.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.44		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.48 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.72 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.36 m², No overhang
Windows facing South West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	560.6773	661.1806	755.3521	850.7274	915.4613	902.0110	859.5809	796.3376	725.2740	630.5153	553.8114	527.3462	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9913	0.9846	0.9703	0.9349	0.8607	0.7308	0.5895	0.6418	0.8394	0.9550	0.9858	0.9929	(86)
MIT	18.9067	19.1333	19.5090	20.0148	20.4694	20.7972	20.9283	20.9035	20.6464	20.0554	19.3998	18.8804	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9893	0.9809	0.9628	0.9173	0.8197	0.6473	0.4625	0.5181	0.7768	0.9395	0.9818	0.9912	(89)
MIT 2	17.0402	17.3719	17.9185	18.6520	19.2782	19.6969	19.8262	19.8110	19.5281	18.7229	17.7729	17.0105	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3648	17.6783	18.1951	18.8891	19.4854	19.8883	20.0179	20.0011	19.7226	18.9547	18.0559	17.3358	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2148	17.5283	18.0451	18.7391	19.3354	19.7383	19.8679	19.8511	19.5726	18.8047	17.9059	17.1858	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9820	0.9699	0.9463	0.8946	0.7972	0.6367	0.4630	0.5161	0.7572	0.9192	0.9713	0.9850	(94)
Useful gains	550.5824	641.2938	714.8046	761.0745	729.7772	574.3083	397.9815	411.0053	549.1691	579.5537	537.9341	519.4543	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1727.2338	1682.6367	1532.6890	1283.6924	992.9111	657.9499	418.4481	440.6283	704.9575	1066.9479	1414.5669	1711.6795	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.4287	699.7824	608.5060	376.2849	195.7716	0.0000	0.0000	0.0000	0.0000	362.6213	631.1756	887.0155	(98)
Space heating												4636.5860	(98)
Space heating per m2											(98) / (4) =	46.0070	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5123.2994	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.4287	699.7824	608.5060	376.2849	195.7716	0.0000	0.0000	0.0000	0.0000	362.6213	631.1756	887.0155	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	967.3245	773.2402	672.3823	415.7844	216.3222	0.0000	0.0000	0.0000	0.0000	400.6866	697.4316	980.1276	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9472	89.9036	89.8129	89.6036	89.1575	87.3000	87.3000	87.3000	87.3000	89.5550	89.8397	89.9664	(217)
Fuel for water heating, kWh/month													
	196.0560	171.9929	178.7013	157.6238	153.0896	136.5557	128.1658	144.7599	145.8047	163.6885	176.2165	190.3116	(219)
Water heating fuel used												1942.9664	(219)
Annual totals kWh/year													
Space heating fuel - main system												5123.2994	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6353.8912	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5123.2994	0.2160	1106.6327	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.9664	0.2160	419.6807	(264)
Space and water heating			1526.3134	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1156.5910	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4800	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		28.4605	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.4605	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625	(83)
Total gains	554.6334	641.0309	720.1582	798.5811	850.2411	834.6064	795.8466	742.8409	683.9939	606.1341	543.9251	524.0983	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9986	0.9970	0.9923	0.9759	0.9242	0.7966	0.6339	0.6911	0.9013	0.9851	0.9972	0.9990	(86)
MIT	19.5814	19.7340	19.9922	20.3470	20.6730	20.8992	20.9746	20.9618	20.7947	20.3750	19.9209	19.5641	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9981	0.9959	0.9894	0.9657	0.8895	0.7071	0.4953	0.5551	0.8421	0.9770	0.9960	0.9986	(89)
MIT 2	17.9911	18.2165	18.5950	19.1175	19.5683	19.8481	19.9102	19.9059	19.7376	19.1650	18.5015	17.9751	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9938	0.9853	0.9585	0.8838	0.7175	0.5193	0.5781	0.8426	0.9713	0.9940	0.9977	(94)
Useful gains	552.9672	637.0497	709.5866	765.4202	751.4169	598.8320	413.2815	429.4638	576.3338	588.7382	540.6688	522.8967	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1759.7186	1704.9358	1543.6154	1283.8461	988.9717	656.7301	422.6712	444.9405	707.9237	1076.7071	1438.1713	1746.1794	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating												4705.3404	(98)
Space heating per m2											(98) / (4) =	46.6892	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5037.8377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	961.2666	768.3292	664.3655	399.6431	189.2299	0.0000	0.0000	0.0000	0.0000	388.7033	691.8649	974.4351	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2698	88.1007	87.7372	86.9019	85.1478	80.3000	80.3000	80.3000	80.3000	86.7375	87.8490	88.3328	(217)
Fuel for water heating, kWh/month													
	241.4868	213.2667	224.9306	202.1588	199.7575	186.5567	178.7355	199.2482	201.4487	211.5298	220.7962	235.5205	(219)
Water heating fuel used												2515.4359	(219)
Annual totals kWh/year													
Space heating fuel - main system												5037.8377	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8059.4561	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5037.8377	0.2160	1088.1729	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.4359	0.2160	543.3341	(264)
Space and water heating			1631.5071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1894.2158	(272)
Emissions per m2 for space and water heating			16.1888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1888 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.3895	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3895	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4967	0.4869	0.4772	0.4285	0.4188	0.3701	0.3701	0.3603	0.3895	0.4188	0.4382	0.4577	(22b)
Effective ac	0.6233	0.6185	0.6139	0.5918	0.5877	0.5685	0.5685	0.5649	0.5759	0.5877	0.5960	0.6047	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.5886	53.1769	52.7733	50.8776	50.5230	48.8719	48.8719	48.5662	49.5079	50.5230	51.2405	51.9906	(38)
Heat transfer coeff	131.5477	131.1359	130.7323	128.8367	128.4820	126.8310	126.8310	126.5252	127.4669	128.4820	129.1995	129.9496	(39)
Average = Sum(39)m / 12 =												128.8350	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3053	1.3012	1.2972	1.2784	1.2749	1.2585	1.2585	1.2555	1.2648	1.2749	1.2820	1.2894	(40)
HLP (average)												1.2784	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	526.7625	628.0989	724.0004	821.7304	887.9950	876.6975	836.0939	770.5068	698.6077	601.4122	521.9596	494.2610	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9953	34.1020	34.2073	34.7106	34.8064	35.2595	35.2595	35.3447	35.0836	34.8064	34.6131	34.4133	
alpha	3.2664	3.2735	3.2805	3.3140	3.3204	3.3506	3.3506	3.3563	3.3389	3.3204	3.3075	3.2942	
util living area													
	0.9928	0.9866	0.9733	0.9395	0.8674	0.7397	0.5983	0.6532	0.8491	0.9599	0.9880	0.9942	(86)
MIT	18.9003	19.1271	19.5031	20.0064	20.4633	20.7928	20.9266	20.9000	20.6372	20.0408	19.3849	18.8695	(87)
Th 2	19.8367	19.8399	19.8430	19.8578	19.8606	19.8735	19.8735	19.8759	19.8685	19.8606	19.8550	19.8491	(88)
util rest of house													
	0.9911	0.9835	0.9665	0.9230	0.8279	0.6573	0.4714	0.5299	0.7888	0.9458	0.9846	0.9928	(89)
MIT 2	17.9278	18.1555	18.5301	19.0328	19.4645	19.7560	19.8468	19.8359	19.6351	19.0757	18.4243	17.9061	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0970	18.3245	18.6993	19.2022	19.6383	19.9364	20.0346	20.0210	19.8094	19.2436	18.5914	18.0737	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0970	18.3245	18.6993	19.2022	19.6383	19.9364	20.0346	20.0210	19.8094	19.2436	18.5914	18.0737	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9875	0.9777	0.9576	0.9110	0.8187	0.6625	0.4912	0.5476	0.7850	0.9356	0.9793	0.9897	(94)
Useful gains	520.1541	614.0853	693.3202	748.5997	726.9690	580.8415	410.6754	421.9449	548.4068	562.7001	511.1769	489.1901	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1814.9575	1760.4311	1594.8451	1327.2990	1019.9233	676.8182	435.6177	458.1488	727.7608	1110.5495	1484.6819	1802.8841	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	963.3337	770.3444	670.7345	416.6635	217.9580	0.0000	0.0000	0.0000	0.0000	407.6000	700.9236	977.3884	(98)
Space heating												5124.9461	(98)
Space heating per m2											(98) / (4) =	50.8528	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1192.2110	938.5491	961.5916	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7494	0.8213	0.7877	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	893.4346	770.8532	757.4737	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1130.8406	1081.1498	1006.5616	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.9323	230.8606	185.3214	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												587.1144	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.7331	57.7152	46.3304	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												146.7786	(107)
Space cooling per m2												1.4564	(108)
Energy for space heating												50.8528	(99)
Energy for space cooling												1.4564	(108)
Total												52.3092	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625 (83)
Total gains	508.3486	595.5751	676.4238	757.6246	811.4850	798.6707	761.7292	705.7127	645.3569	564.6371	499.6931	478.6391 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9990	0.9978	0.9941	0.9803	0.9348	0.8160	0.6565	0.7172	0.9173	0.9888	0.9980	0.9993	(86)
MIT	19.5393	19.6930	19.9535	20.3133	20.6479	20.8871	20.9705	20.9551	20.7721	20.3393	19.8808	19.5225	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9987	0.9970	0.9918	0.9718	0.9036	0.7292	0.5157	0.5806	0.8642	0.9825	0.9972	0.9991	(89)
MIT 2	18.5484	18.7045	18.9667	19.3345	19.6542	19.8639	19.9121	19.9088	19.7769	19.3656	18.9052	18.5423	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9959	0.9896	0.9676	0.9008	0.7405	0.5404	0.6042	0.8664	0.9795	0.9963	0.9987	(94)
Useful gains	507.4319	593.1621	669.3910	733.1045	730.9497	591.3996	411.6494	426.4181	559.1304	553.0788	497.8355	477.9976	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1816.7931	1754.6483	1581.1855	1305.1901	997.1450	658.0460	422.7717	445.0917	711.3938	1096.2806	1478.4834	1803.5035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	974.1647	780.5187	678.3751	411.9016	198.0493	0.0000	0.0000	0.0000	0.0000	404.1421	706.0665	986.1764	(98)
Space heating												5139.3944	(98)
Space heating per m2											(98) / (4) =	50.9962	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7903	0.8699	0.8360	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.3316	778.3744	766.1862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.6404	994.2300	930.8283	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	101.7424	160.5966	122.4937	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												384.8327	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	25.4356	40.1491	30.6234	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												96.2082 (107)
Space cooling per m2												0.9546 (108)
Energy for space heating												50.9962 (99)
Energy for space cooling												0.9546 (108)
Total												51.9508 (109)
Target Fabric Energy Efficiency (TFEE)												59.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.4279	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
Energy conte   162.2010   141.8620   146.3889   127.6254   122.4596   105.6733    97.9219   112.3668   113.7088   132.5167   144.6523   157.0830 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1564.4598 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.3302    21.2793    21.9583    19.1438    18.3689    15.8510    14.6883    16.8550    17.0563    19.8775    21.6978    23.5625 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1458    12.7657    14.1079    13.6113    14.0313    13.5398    13.9669    14.0086    13.5787    14.0746    13.6600    14.1336 (61)
Total heat required for water heating calculated for each month
              176.3469   154.6278   160.4968   141.2367   136.4909   119.2131   111.8888   126.3754   127.2875   146.5913   158.3123   171.2166 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                             Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              176.3469   154.6278   160.4968   141.2367   136.4909   119.2131   111.8888   126.3754   127.2875   146.5913   158.3123   171.2166 (64)
                                                                                               Total per year (kWh/year) = Sum(64)m =   1730.0840 (64)
RHI water heating demand                                                                                                                 1730 (64)
Heat gains from water heating, kWh/month
               57.4683    50.3606    52.2013    45.8383    44.2256    38.5213    36.0507    40.8641    41.2029    47.5804    51.5119    55.7635 (65)
```

---

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)

Water heating gains (Table 5)

	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)

Total internal gains

	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	

```
util living area
                0.9734     0.9630     0.9353     0.8728     0.7629     0.5805     0.4413     0.4620     0.7017     0.8868     0.9555     0.9768 (86)
```

MIT	19.3530	19.5235	19.8768	20.3235	20.6901	20.9119	20.9736	20.9700	20.8283	20.4006	19.8421	19.3484	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)

```
util rest of house
                0.9675     0.9549     0.9205     0.8426     0.7044     0.4855     0.3218     0.3384     0.6157     0.8525     0.9438     0.9715 (89)
```

MIT 2	17.7054	17.9560	18.4582	19.0826	19.5599	19.8063	19.8591	19.8601	19.7375	19.2034	18.4255	17.7087	(90)

```
Living area fraction                                                                                 fLA = Living area / (4) =      0.1739 (91)
```

MIT	17.9920	18.2287	18.7050	19.2985	19.7565	19.9986	20.0529	20.0532	19.9272	19.4116	18.6719	17.9939	(92)

```
Temperature adjustment                                                                                                       -0.1500
```

adjusted MIT	17.8420	18.0787	18.5550	19.1485	19.6065	19.8486	19.9029	19.9032	19.7772	19.2616	18.5219	17.8439	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8195	0.6893	0.4838	0.3255	0.3420	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2786	825.4092	877.8017	880.5315	762.1182	548.5575	350.8853	349.0417	573.3657	703.6503	726.1727	724.2094	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)

```
Heat loss rate W
             1677.5704  1641.1317  1488.4596  1235.4677   909.9777   580.7591   356.8691   355.9238   642.9387  1003.7658  1348.6747  1639.9047 (97)
```

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

```
Space heating kWh
              680.2331   548.1655   454.3294   255.5540   110.0075     0.0000     0.0000     0.0000     0.0000   223.2859   448.2014   681.2773 (98)
Space heating                                                                                                               3401.0542 (98)
RHI space heating demand                                                                                                       3401 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7200	
Infiltration rate		0.4279	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9788	0.9676	0.9459	0.8974	0.8070	0.6622	0.5181	0.5628	0.7673	0.9167	0.9674	0.9818	(86)
MIT	19.1525	19.3679	19.7182	20.1810	20.5791	20.8513	20.9513	20.9352	20.7409	20.2317	19.6218	19.1239	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9741	0.9605	0.9335	0.8726	0.7581	0.5761	0.3995	0.4446	0.6935	0.8913	0.9590	0.9778	(89)
MIT 2	17.3957	17.7086	18.2135	18.8759	19.4103	19.7467	19.8395	19.8315	19.6290	18.9615	18.0905	17.3635	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7013	17.9972	18.4752	19.1029	19.6136	19.9388	20.0329	20.0235	19.8224	19.1824	18.3569	17.6697	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5513	17.8472	18.3252	18.9529	19.4636	19.7888	19.8829	19.8735	19.6724	19.0324	18.2069	17.5197	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9433	0.9119	0.8485	0.7390	0.5698	0.4016	0.4454	0.6795	0.8676	0.9418	0.9657	(94)
Useful gains	738.8536	817.7281	867.8071	876.9482	801.2402	604.0574	406.9102	424.2792	605.4091	702.5036	703.5139	706.1096	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1772.2280	1725.1313	1569.8748	1311.5909	1009.5838	664.4185	420.3723	443.4877	717.8127	1096.5572	1453.9653	1755.6937	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	768.8305	609.7750	522.3383	312.9427	155.0077	0.0000	0.0000	0.0000	0.0000	293.1759	540.3250	780.8906	(98)
Space heating												3983.2857	(98)
Space heating per m2											(98) / (4) =	39.5246	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4401.4206	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	768.8305	609.7750	522.3383	312.9427	155.0077	0.0000	0.0000	0.0000	0.0000	293.1759	540.3250	780.8906	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	849.5365	673.7845	577.1694	345.7931	171.2792	0.0000	0.0000	0.0000	0.0000	323.9513	597.0442	862.8625	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8853	89.8339	89.7269	89.4800	88.9729	87.3000	87.3000	87.3000	87.3000	89.4076	89.7545	89.9074	(217)
Fuel for water heating, kWh/month													
	196.1910	172.1263	178.8725	157.8415	153.4072	136.5557	128.1658	144.7599	145.8047	163.9584	176.3837	190.4367	(219)
Water heating fuel used												1944.5036	(219)
Annual totals kWh/year													
Space heating fuel - main system												4401.4206	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5633.5497	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4401.4206	3.4800	153.1694	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.5036	3.4800	67.6687	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			246.8760	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7113	(257)
SAP value		90.0779	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4401.4206	0.2160	950.7069	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.5036	0.2160	420.0128	(264)
Space and water heating			1370.7196	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1000.9973	(272)
CO2 emissions per m2			9.9300	(273)
EI value			90.7989	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	
util living area													
	0.9734	0.9630	0.9353	0.8728	0.7629	0.5805	0.4413	0.4620	0.7017	0.8868	0.9555	0.9768	(86)
MIT	19.3530	19.5235	19.8768	20.3235	20.6901	20.9119	20.9736	20.9700	20.8283	20.4006	19.8421	19.3484	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)
util rest of house													
	0.9675	0.9549	0.9205	0.8426	0.7044	0.4855	0.3218	0.3384	0.6157	0.8525	0.9438	0.9715	(89)
MIT 2	17.7054	17.9560	18.4582	19.0826	19.5599	19.8063	19.8591	19.8601	19.7375	19.2034	18.4255	17.7087	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9920	18.2287	18.7050	19.2985	19.7565	19.9986	20.0529	20.0532	19.9272	19.4116	18.6719	17.9939	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8420	18.0787	18.5550	19.1485	19.6065	19.8486	19.9029	19.9032	19.7772	19.2616	18.5219	17.8439	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8195	0.6893	0.4838	0.3255	0.3420	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2786	825.4092	877.8017	880.5315	762.1182	548.5575	350.8853	349.0417	573.3657	703.6503	726.1727	724.2094	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1677.5704	1641.1317	1488.4596	1235.4677	909.9777	580.7591	356.8691	355.9238	642.9387	1003.7658	1348.6747	1639.9047	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	680.2331	548.1655	454.3294	255.5540	110.0075	0.0000	0.0000	0.0000	0.0000	223.2859	448.2014	681.2773	(98)
Space heating												3401.0542	(98)
Space heating per m2											(98) / (4) =	33.7473	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3758.0709	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	680.2331	548.1655	454.3294	255.5540	110.0075	0.0000	0.0000	0.0000	0.0000	223.2859	448.2014	681.2773	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	751.6388	605.7077	502.0215	282.3802	121.5552	0.0000	0.0000	0.0000	0.0000	246.7248	495.2502	752.7926	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8222	89.7760	89.6422	89.3344	88.6997	87.3000	87.3000	87.3000	87.3000	89.2041	89.6423	89.8386	(217)
Fuel for water heating, kWh/month													
	196.3289	172.2374	179.0415	158.0988	153.8798	136.5557	128.1658	144.7599	145.8047	164.3324	176.6044	190.5824	(219)
Water heating fuel used												1946.3917	(219)
Annual totals kWh/year													
Space heating fuel - main system												3758.0709	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4841.6680	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3758.0709	10.2300	384.4507	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.3917	10.2300	199.1159	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			369.7484	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3758.0709	0.2160	811.7433	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.3917	0.2160	420.4206	(264)
Space and water heating			1232.1639	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			784.3735	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3758.0709	1.2200	4584.8465	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.3917	1.2200	2374.5979	(264)
Space and water heating			6959.4444	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4310.6651	(272)
Primary energy kWh/m2/year			42.7730	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (24.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 91	A 93
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£186	£204	-£18
Mains gas	£687	£583	£104
Space heating	£515	£515	£0
Water heating	£199	£114	£85
Lighting	£158	£158	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£370	£284	£86
Total cost of uses	£369	£284	£85
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	32 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7200	
Infiltration rate			0.4279	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5456	0.5349	0.5242	0.4707	0.4600	0.4065	0.4065	0.3958	0.4279	0.4600	0.4814	0.5028	(22b)
Effective ac	0.6488	0.6431	0.6374	0.6108	0.6058	0.5826	0.5826	0.5783	0.5916	0.6058	0.6159	0.6264	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7813	55.2844	54.7974	52.5097	52.0817	50.0892	50.0892	49.7202	50.8567	52.0817	52.9476	53.8528	(38)
Heat transfer coeff	133.7403	133.2435	132.7564	130.4688	130.0407	128.0483	128.0483	127.6793	128.8157	130.0407	130.9066	131.8118	(39)
Average = Sum(39)m / 12 =												130.4667	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3271	1.3221	1.3173	1.2946	1.2903	1.2706	1.2706	1.2669	1.2782	1.2903	1.2989	1.3079	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4379	33.5626	33.6857	34.2764	34.3892	34.9243	34.9243	35.0252	34.7162	34.3892	34.1617	33.9271	
alpha	3.2292	3.2375	3.2457	3.2851	3.2926	3.3283	3.3283	3.3350	3.3144	3.2926	3.2774	3.2618	
util living area													
	0.9788	0.9676	0.9459	0.8974	0.8070	0.6622	0.5181	0.5628	0.7673	0.9167	0.9674	0.9818	(86)
MIT	19.1525	19.3679	19.7182	20.1810	20.5791	20.8513	20.9513	20.9352	20.7409	20.2317	19.6218	19.1239	(87)
Th 2	19.8197	19.8235	19.8273	19.8451	19.8484	19.8640	19.8640	19.8668	19.8580	19.8484	19.8417	19.8346	(88)
util rest of house													
	0.9741	0.9605	0.9335	0.8726	0.7581	0.5761	0.3995	0.4446	0.6935	0.8913	0.9590	0.9778	(89)
MIT 2	17.3957	17.7086	18.2135	18.8759	19.4103	19.7467	19.8395	19.8315	19.6290	18.9615	18.0905	17.3635	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7013	17.9972	18.4752	19.1029	19.6136	19.9388	20.0329	20.0235	19.8224	19.1824	18.3569	17.6697	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5513	17.8472	18.3252	18.9529	19.4636	19.7888	19.8829	19.8735	19.6724	19.0324	18.2069	17.5197	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9433	0.9119	0.8485	0.7390	0.5698	0.4016	0.4454	0.6795	0.8676	0.9418	0.9657	(94)
Useful gains	738.8536	817.7281	867.8071	876.9482	801.2402	604.0574	406.9102	424.2792	605.4091	702.5036	703.5139	706.1096	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1772.2280	1725.1313	1569.8748	1311.5909	1009.5838	664.4185	420.3723	443.4877	717.8127	1096.5572	1453.9653	1755.6937	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	768.8305	609.7750	522.3383	312.9427	155.0077	0.0000	0.0000	0.0000	0.0000	293.1759	540.3250	780.8906	(98)
Space heating												3983.2857	(98)
Space heating per m2											(98) / (4) =	39.5246	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4401.4206	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	768.8305	609.7750	522.3383	312.9427	155.0077	0.0000	0.0000	0.0000	0.0000	293.1759	540.3250	780.8906	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	849.5365	673.7845	577.1694	345.7931	171.2792	0.0000	0.0000	0.0000	0.0000	323.9513	597.0442	862.8625	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9583	89.9861	90.0204	90.0834	90.1592	87.3000	87.3000	87.3000	87.3000	89.7094	89.8675	89.9683	(217)
Fuel for water heating, kWh/month	167.9981	125.0696	98.6724	50.1566	19.7698	2.9152	0.0000	29.5406	55.5649	103.4387	142.8763	166.8510	(219)
Water heating fuel used												962.8532	(219)
Annual totals kWh/year													
Space heating fuel - main system												4401.4206	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4701.8993	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4401.4206	3.4800	153.1694	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.8532	3.4800	33.5073	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			219.3095	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6318	(257)
SAP value	91.1858	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4401.4206	0.2160	950.7069	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.8532	0.2160	207.9763	(264)
Space and water heating			1158.6831	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			814.9108	(272)
CO2 emissions per m2			8.0900	(273)
EI value			92.5094	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.7200	
Infiltration rate				0.4279	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4493	0.4172	0.4279	0.4065	0.4065	0.3958	0.3851	0.3744	0.3637	0.3958	0.3744	0.3958	(22b)
Effective ac	0.6009	0.5870	0.5916	0.5826	0.5826	0.5783	0.5742	0.5701	0.5662	0.5783	0.5701	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6635	50.4680	50.8567	50.0892	50.0892	49.7202	49.3611	49.0118	48.6723	49.7202	49.0118	49.7202	(38)
Heat transfer coeff	129.6226	128.4271	128.8157	128.0483	128.0483	127.6793	127.3202	126.9709	126.6314	127.6793	126.9709	127.6793	(39)
Average = Sum(39)m / 12 =												127.8244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2862	1.2743	1.2782	1.2706	1.2706	1.2669	1.2633	1.2599	1.2565	1.2669	1.2599	1.2669	(40)
HLP (average)												1.2684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5002	34.8213	34.7162	34.9243	34.9243	35.0252	35.1240	35.2207	35.3151	35.0252	35.2207	35.0252	
alpha	3.3000	3.3214	3.3144	3.3283	3.3283	3.3350	3.3416	3.3480	3.3543	3.3350	3.3480	3.3350	
util living area													
	0.9734	0.9630	0.9353	0.8728	0.7629	0.5805	0.4413	0.4620	0.7017	0.8868	0.9555	0.9768	(86)
MIT	19.3530	19.5235	19.8768	20.3235	20.6901	20.9119	20.9736	20.9700	20.8283	20.4006	19.8421	19.3484	(87)
Th 2	19.8517	19.8610	19.8580	19.8640	19.8640	19.8668	19.8697	19.8724	19.8751	19.8668	19.8724	19.8668	(88)
util rest of house													
	0.9675	0.9549	0.9205	0.8426	0.7044	0.4855	0.3218	0.3384	0.6157	0.8525	0.9438	0.9715	(89)
MIT 2	17.7054	17.9560	18.4582	19.0826	19.5599	19.8063	19.8591	19.8601	19.7375	19.2034	18.4255	17.7087	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	17.9920	18.2287	18.7050	19.2985	19.7565	19.9986	20.0529	20.0532	19.9272	19.4116	18.6719	17.9939	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8420	18.0787	18.5550	19.1485	19.6065	19.8486	19.9029	19.9032	19.7772	19.2616	18.5219	17.8439	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8195	0.6893	0.4838	0.3255	0.3420	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2786	825.4092	877.8017	880.5315	762.1182	548.5575	350.8853	349.0417	573.3657	703.6503	726.1727	724.2094	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1677.5704	1641.1317	1488.4596	1235.4677	909.9777	580.7591	356.8691	355.9238	642.9387	1003.7658	1348.6747	1639.9047	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	680.2331	548.1655	454.3294	255.5540	110.0075	0.0000	0.0000	0.0000	0.0000	223.2859	448.2014	681.2773	(98)

Space heating 3401.0542 (98)
Space heating per m2 (98) / (4) = 33.7473 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3758.0709 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	680.2331	548.1655	454.3294	255.5540	110.0075	0.0000	0.0000	0.0000	0.0000	223.2859	448.2014	681.2773	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	751.6388	605.7077	502.0215	282.3802	121.5552	0.0000	0.0000	0.0000	0.0000	246.7248	495.2502	752.7926	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9149	89.9380	89.9631	90.0164	89.9473	87.3000	87.3000	87.3000	87.3000	89.5668	89.7895	89.9153	(217)
Fuel for water heating, kWh/month	163.2946	125.2543	98.2059	48.7608	24.6306	0.0000	0.0000	22.1819	49.8346	98.9957	137.4292	163.4227	(219)

Water heating fuel used 932.0104 (219)
Annual totals kWh/year
Space heating fuel - main system 3758.0709 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 431.1826 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771 -1368.9771 (233)
Total delivered energy for all uses 3877.2867 (238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3758.0709	10.2300	384.4507	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	932.0104	10.2300	95.3447	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			284.3371	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3758.0709	0.2160	811.7433	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0104	0.2160	201.3142	(264)
Space and water heating			1013.0576	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			591.2172 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3758.0709	1.2200	4584.8465	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0104	1.2200	1137.0527	(264)
Space and water heating			5721.8991	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3226.6198	(272)
Primary energy kWh/m2/year			32.0165	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	343.88	(P1)
Transmission heat loss coefficient	77.96	(37)
Summer heat loss coefficient	421.84	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.3600	98.8453	0.4600	0.0000	0.9000	260.2635
South West	5.0200	119.9223	0.4600	0.0000	0.9000	249.2322
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						674.8231

	Jun	Jul	Aug	
Solar gains	716	675	600	(P4)
Internal gains	488	468	477	
Total summer gains	1204	1143	1077	(P5)
Summer gain/loss ratio	2.86	2.71	2.55	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.74	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-330	**Issued on Date**	06/07/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	26, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.00	**TER**	18.63
Environmental	91 B	**% DER<TER**	40.97		
CO_2 Emissions (t/year)	0.70	**DFEE**	50.65	**TFEE**	57.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.06		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.00 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.7 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.52 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.06 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 7.64 m², No overhang
Windows facing North West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5200	
Infiltration rate		0.3877	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4943	0.4846	0.4749	0.4264	0.4168	0.3683	0.3683	0.3586	0.3877	0.4168	0.4361	0.4555	(22b)
Effective ac	0.6222	0.6174	0.6128	0.5909	0.5868	0.5678	0.5678	0.5643	0.5751	0.5868	0.5951	0.6037	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7963	50.4091	50.0294	48.2464	47.9128	46.3598	46.3598	46.0722	46.9579	47.9128	48.5876	49.2932	(38)
Heat transfer coeff	124.5810	124.1937	123.8141	122.0310	121.6974	120.1444	120.1444	119.8568	120.7426	121.6974	122.3723	123.0778	(39)
Average = Sum(39)m / 12 =												122.0294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3017	1.2976	1.2936	1.2750	1.2715	1.2553	1.2553	1.2523	1.2615	1.2715	1.2786	1.2859	(40)
HLP (average)												1.2750	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	547.6176	645.8487	736.7382	827.4201	888.1523	874.1383	833.3911	773.8226	706.8911	615.9443	541.2018	515.0665	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0075	36.1198	36.2306	36.7600	36.8607	37.3372	37.3372	37.4268	37.1522	36.8607	36.6574	36.4473	
alpha	3.4005	3.4080	3.4154	3.4507	3.4574	3.4891	3.4891	3.4951	3.4768	3.4574	3.4438	3.4298	
util living area													
	0.9921	0.9855	0.9713	0.9355	0.8590	0.7250	0.5799	0.6324	0.8357	0.9556	0.9867	0.9936	(86)
MIT	19.0426	19.2628	19.6226	20.0998	20.5270	20.8260	20.9416	20.9201	20.6884	20.1317	19.5059	19.0114	(87)
Th 2	19.8395	19.8427	19.8458	19.8605	19.8632	19.8760	19.8760	19.8784	19.8711	19.8632	19.8577	19.8519	(88)
util rest of house													
	0.9902	0.9820	0.9639	0.9176	0.8170	0.6401	0.4534	0.5083	0.7710	0.9398	0.9828	0.9920	(89)
MIT 2	17.2404	17.5623	18.0852	18.7751	19.3601	19.7359	19.8464	19.8339	19.5853	18.8331	17.9276	17.2023	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.5145	17.8210	18.3190	18.9766	19.5376	19.9017	20.0130	19.9991	19.7531	19.0306	18.1677	17.4775	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3645	17.6710	18.1690	18.8266	19.3876	19.7517	19.8630	19.8491	19.6031	18.8806	18.0177	17.3275	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9717	0.9482	0.8958	0.7954	0.6294	0.4518	0.5046	0.7520	0.9202	0.9730	0.9864	(94)
Useful gains	538.5959	627.5837	698.5973	741.2377	706.4160	550.1664	376.5651	390.5083	531.5838	566.8133	526.6080	508.0681	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1627.5928	1586.0777	1444.7920	1211.3564	935.5623	618.9466	392.0333	413.3991	664.4588	1007.7306	1336.0230	1615.7063	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	810.2137	644.1080	555.1688	338.4854	170.4849	0.0000	0.0000	0.0000	0.0000	328.0425	582.7788	824.0828	(98)
Space heating												4253.3649	(98)
Space heating per m2											(98) / (4) =	44.4401	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4699.8507	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	810.2137	644.1080	555.1688	338.4854	170.4849	0.0000	0.0000	0.0000	0.0000	328.0425	582.7788	824.0828	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	895.2637	711.7215	613.4462	374.0170	188.3811	0.0000	0.0000	0.0000	0.0000	362.4779	643.9545	910.5887	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9163	89.8680	89.7684	89.5412	89.0573	87.3000	87.3000	87.3000	87.3000	89.4945	89.8029	89.9381	(217)
Fuel for water heating, kWh/month													
	193.9412	170.1514	176.8172	156.0057	151.5949	135.0886	126.8064	143.1997	144.2255	162.0079	174.3399	188.2587	(219)
Water heating fuel used												1922.4372	(219)
Annual totals kWh/year													
Space heating fuel - main system												4699.8507	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5894.8102	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4699.8507	0.2160	1015.1678	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.4372	0.2160	415.2464	(264)
Space and water heating			1430.4142	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1052.8533	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.0000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.0000	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		28.3484	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.3484	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	541.8754	626.3173	702.6702	776.9384	825.2575	809.2377	771.9855	722.1307	666.7876	592.3217	531.6957	512.0645	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9984	0.9966	0.9913	0.9731	0.9168	0.7829	0.6177	0.6741	0.8909	0.9830	0.9968	0.9988	(86)
MIT	19.6238	19.7772	20.0331	20.3797	20.6964	20.9094	20.9780	20.9667	20.8121	20.4040	19.9549	19.6026	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9979	0.9954	0.9880	0.9619	0.8800	0.6925	0.4822	0.5401	0.8287	0.9740	0.9955	0.9984	(89)
MIT 2	18.0649	18.2910	18.6656	19.1735	19.6083	19.8673	19.9228	19.9190	19.7669	19.2156	18.5609	18.0419	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9930	0.9836	0.9541	0.8740	0.7015	0.5026	0.5598	0.8286	0.9677	0.9932	0.9974	(94)
Useful gains	540.0564	621.9495	691.1195	741.2844	721.2339	567.6970	387.9973	404.2737	552.5244	573.1913	528.1042	510.7503	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1646.3431	1596.2378	1446.1712	1205.0655	927.9554	615.8886	395.3902	416.5610	664.4887	1011.0026	1348.8427	1636.0185	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating												4281.1435	(98)
Space heating per m2											(98) / (4) =	44.7304	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4583.6654	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	881.2391	700.9868	601.4544	357.5186	164.6689	0.0000	0.0000	0.0000	0.0000	348.7491	632.6892	896.3593	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1363	87.9508	87.5560	86.6717	84.8292	80.3000	80.3000	80.3000	80.3000	86.5017	87.6928	88.2079	(217)
Fuel for water heating, kWh/month													
	239.6317	211.6837	223.3784	200.2496	198.0880	184.3053	176.5785	196.8436	199.0176	210.2576	219.1990	233.7049	(219)
Water heating fuel used												2492.9379	(219)
Annual totals kWh/year													
Space heating fuel - main system												4583.6654	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7567.6827	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4583.6654	0.2160	990.0717	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2492.9379	0.2160	538.4746	(264)
Space and water heating			1528.5463	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1783.4165	(272)
Emissions per m2 for space and water heating			15.9706	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9706 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.6300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			4.5200	
Infiltration rate			0.3473	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3473	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4428	0.4341	0.4254	0.3820	0.3733	0.3299	0.3299	0.3212	0.3473	0.3733	0.3907	0.4080	(22b)
Effective ac	0.5980	0.5942	0.5905	0.5730	0.5697	0.5544	0.5544	0.5516	0.5603	0.5697	0.5763	0.5832	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.8251	48.5143	48.2097	46.7791	46.5114	45.2653	45.2653	45.0346	45.7453	46.5114	47.0529	47.6190	(38)
Heat transfer coeff	122.6097	122.2990	121.9944	120.5637	120.2960	119.0500	119.0500	118.8192	119.5300	120.2960	120.8375	121.4036	(39)
Average = Sum(39)m / 12 =												120.5624	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2811	1.2778	1.2746	1.2597	1.2569	1.2439	1.2439	1.2415	1.2489	1.2569	1.2625	1.2685	(40)
HLP (average)												1.2597	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	514.0202	613.0743	705.6729	798.6823	860.9265	849.0393	810.0964	748.2124	680.4557	587.1005	509.6425	482.2886	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.5865	36.6794	36.7710	37.2073	37.2901	37.6804	37.6804	37.7536	37.5291	37.2901	37.1230	36.9499	
alpha	3.4391	3.4453	3.4514	3.4805	3.4860	3.5120	3.5120	3.5169	3.5019	3.4860	3.4749	3.4633	
util living area													
	0.9935	0.9876	0.9744	0.9404	0.8662	0.7345	0.5892	0.6444	0.8460	0.9607	0.9889	0.9948	(86)
MIT	19.0335	19.2539	19.6143	20.0898	20.5200	20.8214	20.9399	20.9168	20.6788	20.1158	19.4891	18.9982	(87)
Th 2	19.8557	19.8583	19.8608	19.8726	19.8748	19.8851	19.8851	19.8870	19.8811	19.8748	19.8703	19.8656	(88)
util rest of house													
	0.9919	0.9845	0.9677	0.9236	0.8257	0.6507	0.4627	0.5205	0.7838	0.9465	0.9856	0.9935	(89)
MIT 2	18.0677	18.2886	18.6471	19.1199	19.5240	19.7860	19.8640	19.8549	19.6778	19.1540	18.5327	18.0398	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.2146	18.4354	18.7942	19.2675	19.6755	19.9435	20.0277	20.0164	19.8301	19.3003	18.6781	18.1856	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2146	18.4354	18.7942	19.2675	19.6755	19.9435	20.0277	20.0164	19.8301	19.3003	18.6781	18.1856	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9887	0.9792	0.9593	0.9123	0.8172	0.6556	0.4802	0.5364	0.7804	0.9368	0.9808	0.9908	(94)
Useful gains	508.1915	600.3200	676.9808	728.6018	703.5085	556.6672	388.9840	401.3749	531.0336	549.9707	499.8407	477.8556	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1706.0636	1655.3687	1499.8266	1249.9394	959.4244	636.1490	408.0695	429.7013	684.9179	1046.6161	1399.0750	1697.8989	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	891.2169	708.9927	612.1973	375.3631	190.4015	0.0000	0.0000	0.0000	0.0000	369.5042	647.4487	907.7122	(98)
Space heating												4702.8365	(98)
Space heating per m2											(98) / (4) =	49.1363	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1119.0699	880.9699	903.0262	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7700	0.8405	0.8084	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	861.7206	740.4371	730.0022	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1095.5554	1047.8872	977.5367	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.3610	228.7429	184.1657	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												581.2695	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.0903	57.1857	46.0414	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												145.3174	(107)
Space cooling per m2												1.5183	(108)
Energy for space heating												49.1363	(99)
Energy for space cooling												1.5183	(108)
Total												50.6546	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	495.9064	581.1673	659.2207	736.4400	786.9329	773.6994	738.2437	685.4143	628.5807	551.0827	487.7546	466.9110	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9989	0.9975	0.9933	0.9781	0.9285	0.8034	0.6408	0.7010	0.9085	0.9873	0.9978	0.9992	(86)
MIT	19.5796	19.7342	19.9927	20.3450	20.6711	20.8978	20.9743	20.9605	20.7897	20.3668	19.9128	19.5591	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9986	0.9966	0.9908	0.9687	0.8953	0.7154	0.5026	0.5658	0.8523	0.9803	0.9969	0.9989	(89)
MIT 2	18.6022	18.7587	19.0184	19.3763	19.6858	19.8809	19.9243	19.9214	19.8012	19.4032	18.9484	18.5907	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9955	0.9884	0.9642	0.8921	0.7252	0.5237	0.5861	0.8540	0.9770	0.9958	0.9985	(94)
Useful gains	494.9166	578.5395	651.5698	710.0836	702.0581	561.1144	386.6507	401.7298	536.7805	538.3953	485.7226	466.2178	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1699.1117	1641.9584	1480.4082	1224.2713	935.0719	616.9945	395.4748	416.6864	667.4192	1028.6335	1386.0686	1689.3129	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	895.9212	714.6175	616.6558	370.2151	173.3623	0.0000	0.0000	0.0000	0.0000	364.7372	648.2491	909.9828	(98)
Space heating												4693.7409	(98)
Space heating per m2											(98) / (4) =	49.0413	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8059	0.8823	0.8507	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	859.9201	741.1018	732.1416	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.4958	963.9035	904.1363	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	106.2545	165.7645	127.9641	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												399.9830 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	26.5636	41.4411	31.9910	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												99.9958 (107)
Space cooling per m2												1.0448 (108)
Energy for space heating												49.0413 (99)
Energy for space cooling												1.0448 (108)
Total												50.0861 (109)
Target Fabric Energy Efficiency (TFEE)												57.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.5200	
Infiltration rate			0.3877	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4071	0.3780	0.3877	0.3683	0.3683	0.3586	0.3489	0.3392	0.3295	0.3586	0.3392	0.3586	(22b)
Effective ac	0.5828	0.5714	0.5751	0.5678	0.5678	0.5643	0.5609	0.5575	0.5543	0.5643	0.5575	0.5643	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5868	46.6550	46.9579	46.3598	46.3598	46.0722	45.7922	45.5200	45.2554	46.0722	45.5200	46.0722	(38)
Heat transfer coeff	121.3715	120.4397	120.7426	120.1444	120.1444	119.8568	119.5769	119.3046	119.0400	119.8568	119.3046	119.8568	(39)
Average = Sum(39)m / 12 =												119.9699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2681	1.2584	1.2615	1.2553	1.2553	1.2523	1.2494	1.2465	1.2438	1.2523	1.2465	1.2523	(40)
HLP (average)												1.2535	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (64)

Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)
RHI water heating demand 1711 (64)
Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)
Total internal gains												
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	163.7030	246.0689	363.1435	492.9981	559.5471	619.8165	586.1345	523.2020	429.5280	300.2395	197.2948	136.5399 (83)
Total gains	781.7044	859.0711	951.9295	1044.3213	1072.4307	1098.5155	1045.0739	991.2588	919.3537	827.7524	766.5777	737.5037 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9597	37.2457	37.1522	37.3372	37.3372	37.4268	37.5144	37.6000	37.6836	37.4268	37.6000	37.4268	
alpha	3.4640	3.4830	3.4768	3.4891	3.4891	3.4951	3.5010	3.5067	3.5122	3.4951	3.5067	3.4951	
util living area													
	0.9745	0.9640	0.9358	0.8715	0.7579	0.5712	0.4312	0.4512	0.6934	0.8851	0.9563	0.9779	(86)
MIT	19.4696	19.6328	19.9721	20.3929	20.7316	20.9282	20.9797	20.9768	20.8549	20.4615	19.9295	19.4585	(87)
Th 2	19.8659	19.8736	19.8711	19.8760	19.8760	19.8784	19.8807	19.8830	19.8852	19.8784	19.8830	19.8784	(88)
util rest of house													
	0.9686	0.9558	0.9207	0.8405	0.6981	0.4764	0.3142	0.3301	0.6061	0.8497	0.9445	0.9727	(89)
MIT 2	17.8746	18.1135	18.5952	19.1804	19.6167	19.8305	19.8729	19.8739	19.7717	19.2880	18.5497	17.8670	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1172	18.3446	18.8046	19.3648	19.7863	19.9975	20.0413	20.0417	19.9365	19.4665	18.7596	18.1091	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9672	18.1946	18.6546	19.2148	19.6363	19.8475	19.8913	19.8917	19.7865	19.3165	18.6096	17.9591	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8994	0.8183	0.6836	0.4736	0.3154	0.3311	0.5975	0.8273	0.9259	0.9597	(94)
Useful gains	746.0034	806.5667	856.1582	854.5984	733.1537	520.2757	329.5692	328.1958	549.2745	684.8372	709.7734	707.7847	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1585.9875	1553.0222	1407.2090	1167.1848	857.3917	545.0448	333.7716	333.0588	605.4963	948.8475	1277.7061	1553.2420	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.9482	501.6181	409.9818	225.0621	92.4331	0.0000	0.0000	0.0000	0.0000	196.4237	408.9115	629.0202	(98)
Space heating												3088.3986	(98)
RHI space heating demand												3088	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.5200	
Infiltration rate			0.3877	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4943	0.4846	0.4749	0.4264	0.4168	0.3683	0.3683	0.3586	0.3877	0.4168	0.4361	0.4555	(22b)
Effective ac	0.6222	0.6174	0.6128	0.5909	0.5868	0.5678	0.5678	0.5643	0.5751	0.5868	0.5951	0.6037	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7963	50.4091	50.0294	48.2464	47.9128	46.3598	46.3598	46.0722	46.9579	47.9128	48.5876	49.2932	(38)
Heat transfer coeff	124.5810	124.1937	123.8141	122.0310	121.6974	120.1444	120.1444	119.8568	120.7426	121.6974	122.3723	123.0778	(39)
Average = Sum(39)m / 12 =												122.0294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3017	1.2976	1.2936	1.2750	1.2715	1.2553	1.2553	1.2523	1.2615	1.2715	1.2786	1.2859	(40)
HLP (average)												1.2750	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	750.0514	845.6048	927.4230	1005.0707	1052.2981	1027.9275	982.7469	925.8560	867.9959	790.0833	728.8456	713.0669	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0075	36.1198	36.2306	36.7600	36.8607	37.3372	37.3372	37.4268	37.1522	36.8607	36.6574	36.4473	
alpha	3.4005	3.4080	3.4154	3.4507	3.4574	3.4891	3.4891	3.4951	3.4768	3.4574	3.4438	3.4298	
util living area													
	0.9799	0.9686	0.9465	0.8967	0.8030	0.6541	0.5075	0.5519	0.7604	0.9160	0.9684	0.9828	(86)
MIT	19.2867	19.4954	19.8295	20.2627	20.6322	20.8756	20.9615	20.9480	20.7775	20.3050	19.7259	19.2531	(87)
Th 2	19.8395	19.8427	19.8458	19.8605	19.8632	19.8760	19.8760	19.8784	19.8711	19.8632	19.8577	19.8519	(88)
util rest of house													
	0.9753	0.9614	0.9338	0.8712	0.7528	0.5673	0.3905	0.4346	0.6849	0.8899	0.9600	0.9789	(89)
MIT 2	17.5933	17.8961	18.3765	18.9935	19.4852	19.7803	19.8574	19.8510	19.6785	19.0664	18.2421	17.5525	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8509	18.1394	18.5975	19.1866	19.6597	19.9469	20.0254	20.0179	19.8457	19.2548	18.4679	17.8112	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7009	17.9894	18.4475	19.0366	19.5097	19.7969	19.8754	19.8679	19.6957	19.1048	18.3179	17.6612	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9452	0.9132	0.8481	0.7346	0.5605	0.3904	0.4335	0.6713	0.8671	0.9436	0.9676	(94)
Useful gains	722.0352	799.2650	846.9538	852.4392	773.0609	576.1931	383.6767	401.3208	582.6970	685.0621	687.7466	689.9763	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1669.4990	1625.6168	1479.2729	1236.9786	950.4200	624.3788	393.5204	415.6532	675.6377	1035.0131	1372.7550	1656.7711	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	704.9131	555.3084	470.4454	276.8684	131.9552	0.0000	0.0000	0.0000	0.0000	260.3635	493.2061	719.2954	(98)
Space heating												3612.3554	(98)
Space heating per m2											(98) / (4) =	37.7427	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3991.5529	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	704.9131	555.3084	470.4454	276.8684	131.9552	0.0000	0.0000	0.0000	0.0000	260.3635	493.2061	719.2954	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	778.9095	613.6005	519.8291	305.9319	145.8068	0.0000	0.0000	0.0000	0.0000	287.6945	544.9791	794.8015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8469	89.7894	89.6708	89.4011	88.8529	87.3000	87.3000	87.3000	87.3000	89.3288	89.7077	89.8723	(217)
Fuel for water heating, kWh/month													
	194.0910	170.3004	177.0096	156.2501	151.9437	135.0886	126.8064	143.1997	144.2255	162.3084	174.5250	188.3966	(219)
Water heating fuel used												1924.1452	(219)
Annual totals kWh/year													
Space heating fuel - main system												3991.5529	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5188.2204	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3991.5529	3.4800	138.9060	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1924.1452	3.4800	66.9603	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			229.9120	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6863	(257)
SAP value		90.4267	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3991.5529	0.2160	862.1754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1924.1452	0.2160	415.6154	(264)
Space and water heating			1277.7908	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			900.2299	(272)
CO2 emissions per m2			9.4100	(273)
EI value			91.4270	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5200	
Infiltration rate		0.3877	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4071	0.3780	0.3877	0.3683	0.3683	0.3586	0.3489	0.3392	0.3295	0.3586	0.3392	0.3586	(22b)
Effective ac	0.5828	0.5714	0.5751	0.5678	0.5678	0.5643	0.5609	0.5575	0.5543	0.5643	0.5575	0.5643	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5868	46.6550	46.9579	46.3598	46.3598	46.0722	45.7922	45.5200	45.2554	46.0722	45.5200	46.0722	(38)
Heat transfer coeff	121.3715	120.4397	120.7426	120.1444	120.1444	119.8568	119.5769	119.3046	119.0400	119.8568	119.3046	119.8568	(39)
Average = Sum(39)m / 12 =												119.9699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2681	1.2584	1.2615	1.2553	1.2553	1.2523	1.2494	1.2465	1.2438	1.2523	1.2465	1.2523	(40)
HLP (average)												1.2535	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	163.7030	246.0689	363.1435	492.9981	559.5471	619.8165	586.1345	523.2020	429.5280	300.2395	197.2948	136.5399	(83)
Total gains	781.7044	859.0711	951.9295	1044.3213	1072.4307	1098.5155	1045.0739	991.2588	919.3537	827.7524	766.5777	737.5037	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9597	37.2457	37.1522	37.3372	37.3372	37.4268	37.5144	37.6000	37.6836	37.4268	37.6000	37.4268	
alpha	3.4640	3.4830	3.4768	3.4891	3.4891	3.4951	3.5010	3.5067	3.5122	3.4951	3.5067	3.4951	
util living area													
	0.9745	0.9640	0.9358	0.8715	0.7579	0.5712	0.4312	0.4512	0.6934	0.8851	0.9563	0.9779	(86)
MIT	19.4696	19.6328	19.9721	20.3929	20.7316	20.9282	20.9797	20.9768	20.8549	20.4615	19.9295	19.4585	(87)
Th 2	19.8659	19.8736	19.8711	19.8760	19.8760	19.8784	19.8807	19.8830	19.8852	19.8784	19.8830	19.8784	(88)
util rest of house													
	0.9686	0.9558	0.9207	0.8405	0.6981	0.4764	0.3142	0.3301	0.6061	0.8497	0.9445	0.9727	(89)
MIT 2	17.8746	18.1135	18.5952	19.1804	19.6167	19.8305	19.8729	19.8739	19.7717	19.2880	18.5497	17.8670	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1172	18.3446	18.8046	19.3648	19.7863	19.9975	20.0413	20.0417	19.9365	19.4665	18.7596	18.1091	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9672	18.1946	18.6546	19.2148	19.6363	19.8475	19.8913	19.8917	19.7865	19.3165	18.6096	17.9591	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8994	0.8183	0.6836	0.4736	0.3154	0.3311	0.5975	0.8273	0.9259	0.9597	(94)
Useful gains	746.0034	806.5667	856.1582	854.5984	733.1537	520.2757	329.5692	328.1958	549.2745	684.8372	709.7734	707.7847	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1585.9875	1553.0222	1407.2090	1167.1848	857.3917	545.0448	333.7716	333.0588	605.4963	948.8475	1277.7061	1553.2420	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.9482	501.6181	409.9818	225.0621	92.4331	0.0000	0.0000	0.0000	0.0000	196.4237	408.9115	629.0202	(98)
Space heating												3088.3986	(98)
Space heating per m2											(98) / (4) =	32.2683	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3412.5952	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.9482	501.6181	409.9818	225.0621	92.4331	0.0000	0.0000	0.0000	0.0000	196.4237	408.9115	629.0202	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.5504	554.2741	453.0185	248.6875	102.1360	0.0000	0.0000	0.0000	0.0000	217.0427	451.8360	695.0500	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7820	89.7316	89.5835	89.2472	88.5728	87.3000	87.3000	87.3000	87.3000	89.1128	89.5908	89.8019	(217)
Fuel for water heating, kWh/month													
	194.2312	170.4101	177.1821	156.5196	152.4242	135.0886	126.8064	143.1997	144.2255	162.7018	174.7528	188.5443	(219)
Water heating fuel used												1926.0864	(219)
Annual totals kWh/year													
Space heating fuel - main system												3412.5952	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4460.7838	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3412.5952	10.2300	349.1085	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.0864	10.2300	197.0386	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			326.7831	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3412.5952	0.2160	737.1206	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0864	0.2160	416.0347	(264)
Space and water heating			1153.1552	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			697.5263	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3412.5952	1.2200	4163.3661	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0864	1.2200	2349.8253	(264)
Space and water heating			6513.1915	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3818.0453	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 39.8918 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-192 kg (27.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.00 kg/m²	A 92	A 93
Total Savings	£85	2.00 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£180	£199	-£18
Mains gas	£649	£546	£103
Space heating	£480	£480	£0
Water heating	£197	£112	£85
Lighting	£153	£153	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£326	£242	£85
Total cost of uses	£327	£242	£85
Delivered energy	47 kWh/m²	37 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	40 kWh/m²	29 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5200	
Infiltration rate		0.3877	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4943	0.4846	0.4749	0.4264	0.4168	0.3683	0.3683	0.3586	0.3877	0.4168	0.4361	0.4555	(22b)
Effective ac	0.6222	0.6174	0.6128	0.5909	0.5868	0.5678	0.5678	0.5643	0.5751	0.5868	0.5951	0.6037	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7963	50.4091	50.0294	48.2464	47.9128	46.3598	46.3598	46.0722	46.9579	47.9128	48.5876	49.2932	(38)
Heat transfer coeff	124.5810	124.1937	123.8141	122.0310	121.6974	120.1444	120.1444	119.8568	120.7426	121.6974	122.3723	123.0778	(39)
Average = Sum(39)m / 12 =												122.0294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3017	1.2976	1.2936	1.2750	1.2715	1.2553	1.2553	1.2523	1.2615	1.2715	1.2786	1.2859	(40)
HLP (average)												1.2750	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                                  Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.1734 (H8)
Utilisation factor                                                                                                                    0.5735 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.2325 (H14)
Volume ratio Veff/V                                                                                                                   0.7635 (H15)
Solar storage volume factor                                                                                                           0.9460 (H16)
Solar input                                                                                                                        -865.2421 (H17)
Solar input    -25.0903   -41.8685   -71.3068   -95.5652  -118.0628  -116.0745  -114.5405  -100.0746   -78.3785   -53.5233   -29.7607   -20.9963 (63)
                                                                                        Solar input (sum of months) = Sum(63)m =   -865.2421 (63)
Output from w/h
              149.2944   111.0432    87.4191    44.1241    16.9437     1.8579     0.0000    24.9387    47.5304    91.4649   126.8017   148.3200 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =    849.7380 (64)
Heat gains from water heating, kWh/month
               56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


------------------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
------------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)


------------------------------------------------------------------------------------------------------------------------
6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a     Specific data    Specific data        factor                W
                                                           W/m2     or Table 6b      or Table 6c          Table 6d
------------------------------------------------------------------------------------------------------------------------
Northeast                                5.0600           11.2829          0.4600           0.0000           0.7700           20.2219 (75)
Southeast                                0.7200           36.7938          0.4600           0.0000           0.7700            9.3833 (77)
Southwest                                4.3100           36.7938          0.4600           0.0000           0.7700           56.1695 (79)
Northwest                                0.7200           11.2829          0.4600           0.0000           0.7700            2.8774 (81)
Southwest                                3.3300           36.7938          0.4600           0.0000           0.7700           43.3978 (79)
------------------------------------------------------------------------------------------------------------------------

Solar gains    132.0500   232.6026   338.6369   453.7475   539.4145   549.2286   523.8075   457.7993   378.1701   262.5704   159.5627   112.1031 (83)
Total gains    750.0514   845.6048   927.4230  1005.0707  1052.2981  1027.9275   982.7469   925.8560   867.9959   790.0833   728.8456   713.0669 (84)


------------------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
------------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.0075    36.1198    36.2306    36.7600    36.8607    37.3372    37.3372    37.4268    37.1522    36.8607    36.6574    36.4473
alpha          3.4005     3.4080     3.4154     3.4507     3.4574     3.4891     3.4891     3.4951     3.4768     3.4574     3.4438     3.4298
util living area
                0.9799     0.9686     0.9465     0.8967     0.8030     0.6541     0.5075     0.5519     0.7604     0.9160     0.9684     0.9828 (86)

MIT           19.2867    19.4954    19.8295    20.2627    20.6322    20.8756    20.9615    20.9480    20.7775    20.3050    19.7259    19.2531 (87)
Th 2          19.8395    19.8427    19.8458    19.8605    19.8632    19.8760    19.8760    19.8784    19.8711    19.8632    19.8577    19.8519 (88)
util rest of house
                0.9753     0.9614     0.9338     0.8712     0.7528     0.5673     0.3905     0.4346     0.6849     0.8899     0.9600     0.9789 (89)
MIT 2         17.5933    17.8961    18.3765    18.9935    19.4852    19.7803    19.8574    19.8510    19.6785    19.0664    18.2421    17.5525 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1521 (91)
MIT           17.8509    18.1394    18.5975    19.1866    19.6597    19.9469    20.0254    20.0179    19.8457    19.2548    18.4679    17.8112 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.7009    17.9894    18.4475    19.0366    19.5097    19.7969    19.8754    19.8679    19.6957    19.1048    18.3179    17.6612 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9452	0.9132	0.8481	0.7346	0.5605	0.3904	0.4335	0.6713	0.8671	0.9436	0.9676	(94)
Useful gains	722.0352	799.2650	846.9538	852.4392	773.0609	576.1931	383.6767	401.3208	582.6970	685.0621	687.7466	689.9763	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1669.4990	1625.6168	1479.2729	1236.9786	950.4200	624.3788	393.5204	415.6532	675.6377	1035.0131	1372.7550	1656.7711	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	704.9131	555.3084	470.4454	276.8684	131.9552	0.0000	0.0000	0.0000	0.0000	260.3635	493.2061	719.2954	(98)
Space heating												3612.3554	(98)
Space heating per m2											(98) / (4) =	37.7427	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3991.5529	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	704.9131	555.3084	470.4454	276.8684	131.9552	0.0000	0.0000	0.0000	0.0000	260.3635	493.2061	719.2954	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	778.9095	613.6005	519.8291	305.9319	145.8068	0.0000	0.0000	0.0000	0.0000	287.6945	544.9791	794.8015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9239	89.9506	89.9831	90.0463	90.1241	87.3000	87.3000	87.3000	87.3000	89.6457	89.8266	89.9364	(217)
Fuel for water heating, kWh/month													
	166.0230	123.4491	97.1505	49.0016	18.8004	2.1281	0.0000	28.5666	54.4449	102.0293	141.1627	164.9165	(219)
Water heating fuel used												947.6729	(219)
Annual totals kWh/year													
Space heating fuel - main system												3991.5529	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4261.7481	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3991.5529	3.4800	138.9060	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.6729	3.4800	32.9790	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			202.5257	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6045	(257)
SAP value	91.5671	
SAP rating (Section 12)	92	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3991.5529	0.2160	862.1754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.6729	0.2160	204.6973	(264)
Space and water heating			1066.8728	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			715.2618	(272)
CO2 emissions per m2			7.4700	(273)
EI value			93.1885	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.5200	
Infiltration rate			0.3877	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3877	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4071	0.3780	0.3877	0.3683	0.3683	0.3586	0.3489	0.3392	0.3295	0.3586	0.3392	0.3586	(22b)
Effective ac	0.5828	0.5714	0.5751	0.5678	0.5678	0.5643	0.5609	0.5575	0.5543	0.5643	0.5575	0.5643	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5868	46.6550	46.9579	46.3598	46.3598	46.0722	45.7922	45.5200	45.2554	46.0722	45.5200	46.0722	(38)
Heat transfer coeff	121.3715	120.4397	120.7426	120.1444	120.1444	119.8568	119.5769	119.3046	119.0400	119.8568	119.3046	119.8568	(39)
Average = Sum(39)m / 12 =												119.9699	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2681	1.2584	1.2615	1.2553	1.2553	1.2523	1.2494	1.2465	1.2438	1.2523	1.2465	1.2523	(40)
HLP (average)												1.2535	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3132 (H8)
Utilisation factor                                                                                                                  0.5330 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             98.2325 (H14)
Volume ratio Veff/V                                                                                                                 0.7635 (H15)
Solar storage volume factor                                                                                                         0.9460 (H16)
Solar input                                                                                                                      -899.9506 (H17)
Solar input    -29.3586   -41.7460   -71.7514   -96.8092  -113.7082  -121.4583  -118.9041  -106.4227   -83.3217   -57.6057   -34.7234   -24.1413 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =   -899.9506 (63)
Output from w/h
              145.0261   111.1657    86.9746    42.8801    21.2982     0.0000     0.0000    18.5906    42.5872    87.3824   121.8389   145.1750 (64)
                                                                                                Total per year (kWh/year) = Sum(64)m =    822.9189 (64)
Heat gains from water heating, kWh/month
               56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                           m2          Table 6a    Specific data  Specific data      factor               W
                                                          W/m2    or Table 6b    or Table 6c    Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                                5.0600           14.6176         0.4600         0.0000         0.7700      26.1985 (75)
Southeast                                0.7200           45.1778         0.4600         0.0000         0.7700      11.5214 (77)
Southwest                                4.3100           45.1778         0.4600         0.0000         0.7700      68.9686 (79)
Northwest                                0.7200           14.6176         0.4600         0.0000         0.7700       3.7279 (81)
Southwest                                3.3300           45.1778         0.4600         0.0000         0.7700      53.2866 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    163.7030   246.0689   363.1435   492.9981   559.5471   619.8165   586.1345   523.2020   429.5280   300.2395   197.2948   136.5399 (83)
Total gains    781.7044   859.0711   951.9295  1044.3213  1072.4307  1098.5155  1045.0739   991.2588   919.3537   827.7524   766.5777   737.5037 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.9597    37.2457    37.1522    37.3372    37.3372    37.4268    37.5144    37.6000    37.6836    37.4268    37.6000    37.4268
alpha          3.4640     3.4830     3.4768     3.4891     3.4891     3.4951     3.5010     3.5067     3.5122     3.4951     3.5067     3.4951
util living area
                0.9745     0.9640     0.9358     0.8715     0.7579     0.5712     0.4312     0.4512     0.6934     0.8851     0.9563     0.9779 (86)

MIT           19.4696    19.6328    19.9721    20.3929    20.7316    20.9282    20.9797    20.9768    20.8549    20.4615    19.9295    19.4585 (87)
Th 2          19.8659    19.8736    19.8711    19.8760    19.8760    19.8784    19.8807    19.8830    19.8852    19.8784    19.8830    19.8784 (88)
util rest of house
                0.9686     0.9558     0.9207     0.8405     0.6981     0.4764     0.3142     0.3301     0.6061     0.8497     0.9445     0.9727 (89)
MIT 2         17.8746    18.1135    18.5952    19.1804    19.6167    19.8305    19.8729    19.8739    19.7717    19.2880    18.5497    17.8670 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1521 (91)
MIT           18.1172    18.3446    18.8046    19.3648    19.7863    19.9975    20.0413    20.0417    19.9365    19.4665    18.7596    18.1091 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.9672    18.1946    18.6546    19.2148    19.6363    19.8475    19.8913    19.8917    19.7865    19.3165    18.6096    17.9591 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8994	0.8183	0.6836	0.4736	0.3154	0.3311	0.5975	0.8273	0.9259	0.9597	(94)
Useful gains	746.0034	806.5667	856.1582	854.5984	733.1537	520.2757	329.5692	328.1958	549.2745	684.8372	709.7734	707.7847	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1585.9875	1553.0222	1407.2090	1167.1848	857.3917	545.0448	333.7716	333.0588	605.4963	948.8475	1277.7061	1553.2420	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.9482	501.6181	409.9818	225.0621	92.4331	0.0000	0.0000	0.0000	0.0000	196.4237	408.9115	629.0202	(98)

Space heating 3088.3986 (98)
Space heating per m2 (98) / (4) = 32.2683 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3412.5952 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.9482	501.6181	409.9818	225.0621	92.4331	0.0000	0.0000	0.0000	0.0000	196.4237	408.9115	629.0202	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	690.5504	554.2741	453.0185	248.6875	102.1360	0.0000	0.0000	0.0000	0.0000	217.0427	451.8360	695.0500	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)

Efficiency of water heater 87.3000 (216)

(217)m	89.8795	89.9022	89.9231	89.9722	89.8830	87.3000	87.3000	87.3000	87.3000	89.4900	89.7448	89.8822	(217)

Fuel for water heating, kWh/month

	161.3562	123.6518	96.7210	47.6593	23.6955	0.0000	0.0000	21.2950	48.7826	97.6449	135.7615	161.5170	(219)

Water heating fuel used 918.0849 (219)
Annual totals kWh/year
Space heating fuel - main system 3412.5952 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771 -1368.9771 (233)
Total delivered energy for all uses 3502.7824 (238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3412.5952	10.2300	349.1085	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	918.0849	10.2300	93.9201	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			242.0245	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3412.5952	0.2160	737.1206	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.0849	0.2160	198.3063	(264)
Space and water heating			935.4269	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			505.7480	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3412.5952	1.2200	4163.3661	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.0849	1.2200	1120.0636	(264)
Space and water heating			5283.4298	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2741.7836	(272)
Primary energy kWh/m2/year			28.6468	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	4.3100	119.9223	0.4600	0.0000	0.9000	213.9822
North West	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						651.5849

	Jun	Jul	Aug	
Solar gains	691	652	581	(P4)
Internal gains	476	456	465	
Total summer gains	1167	1108	1046	(P5)
Summer gain/loss ratio	2.91	2.77	2.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.73	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-331	**Issued on Date**	06/07/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-As-DET
Property	25, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.47	**TER**	18.80
Environmental	91 B	**% DER<TER**	38.97		
CO_2 Emissions (t/year)	0.78	**DFEE**	52.30	**TFEE**	59.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.46		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.47 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.71 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.36 m², No overhang
Windows facing South West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.7100	
Infiltration rate				0.4274	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5450	0.5343	0.5236	0.4702	0.4595	0.4061	0.4061	0.3954	0.4274	0.4595	0.4809	0.5022	(22b)
Effective ac	0.6485	0.6427	0.6371	0.6105	0.6056	0.5824	0.5824	0.5782	0.5913	0.6056	0.6156	0.6261	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7514	55.2557	54.7698	52.4875	52.0604	50.0726	50.0726	49.7045	50.8383	52.0604	52.9243	53.8274	(38)
Heat transfer coeff	133.7105	133.2147	132.7288	130.4465	130.0195	128.0317	128.0317	127.6636	128.7974	130.0195	130.8833	131.7865	(39)
Average = Sum(39)m / 12 =												130.4445	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3268	1.3218	1.3170	1.2944	1.2901	1.2704	1.2704	1.2668	1.2780	1.2901	1.2987	1.3077	(40)
HLP (average)												1.2943	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	560.6773	661.1806	755.3521	850.7274	915.4613	902.0110	859.5809	796.3376	725.2740	630.5153	553.8114	527.3462	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4454	33.5698	33.6927	34.2822	34.3948	34.9288	34.9288	35.0296	34.7212	34.3948	34.1678	33.9337	
alpha	3.2297	3.2380	3.2462	3.2855	3.2930	3.3286	3.3286	3.3353	3.3147	3.2930	3.2779	3.2622	
util living area													
	0.9913	0.9846	0.9703	0.9349	0.8606	0.7308	0.5894	0.6418	0.8394	0.9550	0.9858	0.9929	(86)
MIT	18.9072	19.1338	19.5094	20.0151	20.4695	20.7973	20.9283	20.9035	20.6465	20.0556	19.4001	18.8808	(87)
Th 2	19.8199	19.8238	19.8275	19.8452	19.8486	19.8641	19.8641	19.8670	19.8581	19.8486	19.8418	19.8348	(88)
util rest of house													
	0.9893	0.9809	0.9628	0.9173	0.8197	0.6473	0.4625	0.5180	0.7767	0.9395	0.9818	0.9912	(89)
MIT 2	17.0410	17.3727	17.9192	18.6525	19.2786	19.6971	19.8263	19.8112	19.5283	18.7234	17.7735	17.0112	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3656	17.6790	18.1958	18.8895	19.4857	19.8885	20.0180	20.0012	19.7228	18.9551	18.0564	17.3364	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2156	17.5290	18.0458	18.7395	19.3357	19.7385	19.8680	19.8512	19.5728	18.8051	17.9064	17.1864	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9820	0.9699	0.9463	0.8946	0.7971	0.6367	0.4630	0.5161	0.7572	0.9192	0.9713	0.9850	(94)
Useful gains	550.5835	641.2946	714.8034	761.0673	729.7575	574.2812	397.9551	410.9819	549.1532	579.5510	537.9346	519.4552	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.9496	1682.3703	1532.4567	1283.5334	992.7930	657.8873	418.4105	440.5906	704.8866	1066.8241	1414.3837	1711.4358	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.2164	699.6029	608.3341	376.1756	195.6984	0.0000	0.0000	0.0000	0.0000	362.5312	631.0434	886.8336	(98)
Space heating												4635.4355	(98)
Space heating per m2											(98) / (4) =	45.9956	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5122.0282	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.2164	699.6029	608.3341	376.1756	195.6984	0.0000	0.0000	0.0000	0.0000	362.5312	631.0434	886.8336	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	967.0899	773.0419	672.1924	415.6636	216.2414	0.0000	0.0000	0.0000	0.0000	400.5870	697.2855	979.9266	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9471	89.9035	89.8128	89.6035	89.1572	87.3000	87.3000	87.3000	87.3000	89.5548	89.8395	89.9664	(217)
Fuel for water heating, kWh/month													
	196.0562	171.9931	178.7016	157.6241	153.0901	136.5557	128.1658	144.7599	145.8047	163.6888	176.2167	190.3118	(219)
Water heating fuel used												1942.9687	(219)
Annual totals kWh/year													
Space heating fuel - main system												5122.0282	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6352.6223	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5122.0282	0.2160	1106.3581	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.9687	0.2160	419.6812	(264)
Space and water heating			1526.0393	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1156.3169	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4700	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		28.4505	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.4505	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625	(83)
Total gains	554.6334	641.0309	720.1582	798.5811	850.2411	834.6064	795.8466	742.8409	683.9939	606.1341	543.9251	524.0983	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9986	0.9970	0.9923	0.9759	0.9242	0.7966	0.6339	0.6911	0.9013	0.9851	0.9972	0.9990	(86)
MIT	19.5814	19.7340	19.9922	20.3470	20.6730	20.8992	20.9746	20.9618	20.7947	20.3750	19.9209	19.5641	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9981	0.9959	0.9894	0.9657	0.8895	0.7071	0.4953	0.5551	0.8421	0.9770	0.9960	0.9986	(89)
MIT 2	17.9911	18.2165	18.5950	19.1175	19.5683	19.8481	19.9102	19.9059	19.7376	19.1650	18.5015	17.9751	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9938	0.9853	0.9585	0.8838	0.7175	0.5193	0.5781	0.8426	0.9713	0.9940	0.9977	(94)
Useful gains	552.9672	637.0497	709.5866	765.4202	751.4169	598.8320	413.2815	429.4638	576.3338	588.7382	540.6688	522.8967	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1759.7186	1704.9358	1543.6154	1283.8461	988.9717	656.7301	422.6712	444.9405	707.9237	1076.7071	1438.1713	1746.1794	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating												4705.3404	(98)
Space heating per m2											(98) / (4) =	46.6892	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5037.8377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	961.2666	768.3292	664.3655	399.6431	189.2299	0.0000	0.0000	0.0000	0.0000	388.7033	691.8649	974.4351	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2698	88.1007	87.7372	86.9019	85.1478	80.3000	80.3000	80.3000	80.3000	86.7375	87.8490	88.3328	(217)
Fuel for water heating, kWh/month													
	241.4868	213.2667	224.9306	202.1588	199.7575	186.5567	178.7355	199.2482	201.4487	211.5298	220.7962	235.5205	(219)
Water heating fuel used												2515.4359	(219)
Annual totals kWh/year													
Space heating fuel - main system												5037.8377	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8059.4561	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5037.8377	0.2160	1088.1729	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.4359	0.2160	543.3341	(264)
Space and water heating			1631.5071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1894.2158	(272)
Emissions per m2 for space and water heating			16.1888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1888 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.3890	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3890	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4960	0.4863	0.4766	0.4279	0.4182	0.3696	0.3696	0.3599	0.3890	0.4182	0.4377	0.4571	(22b)
Effective ac	0.6230	0.6182	0.6136	0.5916	0.5875	0.5683	0.5683	0.5648	0.5757	0.5875	0.5958	0.6045	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.5614	53.1507	52.7482	50.8574	50.5036	48.8568	48.8568	48.5518	49.4911	50.5036	51.2193	51.9675	(38)
Heat transfer coeff	131.5205	131.1098	130.7072	128.8164	128.4627	126.8159	126.8159	126.5109	127.4502	128.4627	129.1783	129.9265	(39)
Average = Sum(39)m / 12 =												128.8147	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3050	1.3010	1.2970	1.2782	1.2747	1.2583	1.2583	1.2553	1.2646	1.2747	1.2818	1.2892	(40)
HLP (average)												1.2782	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	526.7625	628.0989	724.0004	821.7304	887.9950	876.6975	836.0939	770.5068	698.6077	601.4122	521.9596	494.2610	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0023	34.1088	34.2139	34.7161	34.8117	35.2637	35.2637	35.3487	35.0882	34.8117	34.6188	34.4194	
alpha	3.2668	3.2739	3.2809	3.3144	3.3208	3.3509	3.3509	3.3566	3.3392	3.3208	3.3079	3.2946	
util living area													
	0.9928	0.9866	0.9733	0.9395	0.8673	0.7396	0.5982	0.6532	0.8491	0.9599	0.9880	0.9942	(86)
MIT	18.9007	19.1275	19.5034	20.0066	20.4635	20.7929	20.9266	20.9001	20.6373	20.0411	19.3852	18.8699	(87)
Th 2	19.8369	19.8401	19.8432	19.8580	19.8607	19.8736	19.8736	19.8760	19.8686	19.8607	19.8551	19.8493	(88)
util rest of house													
	0.9911	0.9835	0.9665	0.9230	0.8278	0.6573	0.4714	0.5299	0.7888	0.9458	0.9846	0.9928	(89)
MIT 2	17.9284	18.1560	18.5306	19.0332	19.4648	19.7562	19.8469	19.8360	19.6353	19.0761	18.4247	17.9066	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0975	18.3250	18.6998	19.2025	19.6385	19.9365	20.0347	20.0211	19.8096	19.2439	18.5918	18.0742	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0975	18.3250	18.6998	19.2025	19.6385	19.9365	20.0347	20.0211	19.8096	19.2439	18.5918	18.0742	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9875	0.9777	0.9576	0.9110	0.8186	0.6625	0.4912	0.5476	0.7850	0.9356	0.9793	0.9897	(94)
Useful gains	520.1548	614.0857	693.3190	748.5933	726.9511	580.8166	410.6505	421.9231	548.3928	562.6978	511.1772	489.1906	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1814.6551	1760.1493	1594.6012	1327.1345	1019.8035	676.7562	435.5803	458.1113	727.6890	1110.4200	1484.4882	1802.6252	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	963.1083	770.1548	670.5540	416.5497	217.8822	0.0000	0.0000	0.0000	0.0000	407.5053	700.7839	977.1953	(98)
Space heating												5123.7334	(98)
Space heating per m2											(98) / (4) =	50.8408	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1192.0691	938.4374	961.4828	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7495	0.8214	0.7878	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	893.4021	770.8135	757.4421	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1130.8406	1081.1498	1006.5616	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.9557	230.8902	185.3449	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												587.1908	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.7389	57.7225	46.3362	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												146.7977	(107)
Space cooling per m2												1.4566	(108)
Energy for space heating												50.8408	(99)
Energy for space cooling												1.4566	(108)
Total												52.2974	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625 (83)
Total gains	508.3486	595.5751	676.4238	757.6246	811.4850	798.6707	761.7292	705.7127	645.3569	564.6371	499.6931	478.6391 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9990	0.9978	0.9941	0.9803	0.9348	0.8160	0.6565	0.7172	0.9173	0.9888	0.9980	0.9993	(86)
MIT	19.5393	19.6930	19.9535	20.3133	20.6479	20.8871	20.9705	20.9551	20.7721	20.3393	19.8808	19.5225	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9987	0.9970	0.9918	0.9718	0.9036	0.7292	0.5157	0.5806	0.8642	0.9825	0.9972	0.9991	(89)
MIT 2	18.5484	18.7045	18.9667	19.3345	19.6542	19.8639	19.9121	19.9088	19.7769	19.3656	18.9052	18.5423	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9959	0.9896	0.9676	0.9008	0.7405	0.5404	0.6042	0.8664	0.9795	0.9963	0.9987	(94)
Useful gains	507.4319	593.1621	669.3910	733.1045	730.9497	591.3996	411.6494	426.4181	559.1304	553.0788	497.8355	477.9976	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1816.7931	1754.6483	1581.1855	1305.1901	997.1450	658.0460	422.7717	445.0917	711.3938	1096.2806	1478.4834	1803.5035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	974.1647	780.5187	678.3751	411.9016	198.0493	0.0000	0.0000	0.0000	0.0000	404.1421	706.0665	986.1764	(98)
Space heating												5139.3944	(98)
Space heating per m2											(98) / (4) =	50.9962	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7903	0.8699	0.8360	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.3316	778.3744	766.1862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.6404	994.2300	930.8283	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	101.7424	160.5966	122.4937	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												384.8327	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	25.4356	40.1491	30.6234	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												96.2082 (107)
Space cooling per m2												0.9546 (108)
Energy for space heating												50.9962 (99)
Energy for space cooling												0.9546 (108)
Total												51.9508 (109)
Target Fabric Energy Efficiency (TFEE)												59.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.4274	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4488	0.4167	0.4274	0.4061	0.4061	0.3954	0.3847	0.3740	0.3633	0.3954	0.3740	0.3954	(22b)
Effective ac	0.6007	0.5868	0.5913	0.5824	0.5824	0.5782	0.5740	0.5699	0.5660	0.5782	0.5699	0.5782	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6432	50.4506	50.8383	50.0726	50.0726	49.7045	49.3462	48.9977	48.6591	49.7045	48.9977	49.7045	(38)
Heat transfer coeff	129.6023	128.4096	128.7974	128.0317	128.0317	127.6636	127.3053	126.9568	126.6181	127.6636	126.9568	127.6636	(39)
Average = Sum(39)m / 12 =												127.8084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2860	1.2742	1.2780	1.2704	1.2704	1.2668	1.2632	1.2597	1.2564	1.2668	1.2597	1.2668	(40)
HLP (average)												1.2682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5055	34.8260	34.7212	34.9288	34.9288	35.0296	35.1281	35.2246	35.3188	35.0296	35.2246	35.0296	
alpha	3.3004	3.3217	3.3147	3.3286	3.3286	3.3353	3.3419	3.3483	3.3546	3.3353	3.3483	3.3353	
util living area													
	0.9734	0.9630	0.9353	0.8728	0.7628	0.5805	0.4412	0.4619	0.7017	0.8867	0.9555	0.9768	(86)
MIT	19.3533	19.5238	19.8770	20.3237	20.6902	20.9119	20.9737	20.9700	20.8284	20.4008	19.8423	19.3486	(87)
Th 2	19.8518	19.8611	19.8581	19.8641	19.8641	19.8670	19.8698	19.8725	19.8752	19.8670	19.8725	19.8670	(88)
util rest of house													
	0.9674	0.9549	0.9205	0.8426	0.7044	0.4855	0.3218	0.3384	0.6157	0.8524	0.9438	0.9715	(89)
MIT 2	17.7059	17.9565	18.4587	19.0830	19.5602	19.8064	19.8592	19.8603	19.7377	19.2036	18.4259	17.7092	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9925	18.2292	18.7054	19.2988	19.7567	19.9987	20.0530	20.0533	19.9274	19.4119	18.6722	17.9943	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8425	18.0792	18.5554	19.1488	19.6067	19.8487	19.9030	19.9033	19.7774	19.2619	18.5222	17.8443	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8194	0.6893	0.4838	0.3254	0.3419	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2778	825.4071	877.7947	880.5145	762.0869	548.5204	350.8605	349.0188	573.3412	703.6390	726.1703	724.2091	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1677.3765	1640.9663	1488.3027	1235.3485	909.8883	580.7047	356.8407	355.8970	642.8886	1003.6760	1348.5651	1639.7550	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	680.0894	548.0558	454.2179	255.4804	109.9643	0.0000	0.0000	0.0000	0.0000	223.2275	448.1243	681.1661	(98)
Space heating												3400.3258	(98)
RHI space heating demand												3400	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.4274	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5450	0.5343	0.5236	0.4702	0.4595	0.4061	0.4061	0.3954	0.4274	0.4595	0.4809	0.5022	(22b)
Effective ac	0.6485	0.6427	0.6371	0.6105	0.6056	0.5824	0.5824	0.5782	0.5913	0.6056	0.6156	0.6261	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7514	55.2557	54.7698	52.4875	52.0604	50.0726	50.0726	49.7045	50.8383	52.0604	52.9243	53.8274	(38)
Heat transfer coeff	133.7105	133.2147	132.7288	130.4465	130.0195	128.0317	128.0317	127.6636	128.7974	130.0195	130.8833	131.7865	(39)
Average = Sum(39)m / 12 =												130.4445	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3268	1.3218	1.3170	1.2944	1.2901	1.2704	1.2704	1.2668	1.2780	1.2901	1.2987	1.3077	(40)
HLP (average)												1.2943	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

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Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4454	33.5698	33.6927	34.2822	34.3948	34.9288	34.9288	35.0296	34.7212	34.3948	34.1678	33.9337	
alpha	3.2297	3.2380	3.2462	3.2855	3.2930	3.3286	3.3286	3.3353	3.3147	3.2930	3.2779	3.2622	
util living area													
	0.9788	0.9676	0.9459	0.8974	0.8070	0.6621	0.5181	0.5628	0.7673	0.9167	0.9674	0.9818	(86)
MIT	19.1530	19.3684	19.7186	20.1813	20.5793	20.8514	20.9513	20.9352	20.7410	20.2320	19.6221	19.1243	(87)
Th 2	19.8199	19.8238	19.8275	19.8452	19.8486	19.8641	19.8641	19.8670	19.8581	19.8486	19.8418	19.8348	(88)
util rest of house													
	0.9741	0.9605	0.9335	0.8726	0.7581	0.5761	0.3995	0.4446	0.6935	0.8913	0.9590	0.9778	(89)
MIT 2	17.3965	17.7094	18.2142	18.8764	19.4106	19.7469	19.8397	19.8316	19.6292	18.9619	18.0911	17.3642	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7020	17.9980	18.4759	19.1034	19.6139	19.9390	20.0330	20.0236	19.8226	19.1828	18.3574	17.6704	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5520	17.8480	18.3259	18.9534	19.4639	19.7890	19.8830	19.8736	19.6726	19.0328	18.2074	17.5204	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9433	0.9119	0.8485	0.7389	0.5698	0.4016	0.4453	0.6795	0.8676	0.9418	0.9657	(94)
Useful gains	738.8537	817.7261	867.8002	876.9319	801.2080	604.0217	406.8799	424.2507	605.3823	702.4941	703.5124	706.1100	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1771.9366	1724.8579	1569.6357	1311.4261	1009.4606	664.3534	420.3337	443.4487	717.7379	1096.4282	1453.7768	1755.4441	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	768.6137	609.5926	522.1656	312.8358	154.9400	0.0000	0.0000	0.0000	0.0000	293.0869	540.1904	780.7046	(98)
Space heating												3982.1295	(98)
Space heating per m2											(98) / (4) =	39.5131	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4400.1431	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	768.6137	609.5926	522.1656	312.8358	154.9400	0.0000	0.0000	0.0000	0.0000	293.0869	540.1904	780.7046	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	849.2969	673.5830	576.9785	345.6749	171.2044	0.0000	0.0000	0.0000	0.0000	323.8530	596.8955	862.6570	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8851	89.8337	89.7268	89.4798	88.9726	87.3000	87.3000	87.3000	87.3000	89.4073	89.7543	89.9072	(217)
Fuel for water heating, kWh/month													
	196.1913	172.1266	178.8729	157.8420	153.4078	136.5557	128.1658	144.7599	145.8047	163.9588	176.3840	190.4369	(219)
Water heating fuel used												1944.5065	(219)
Annual totals kWh/year													
Space heating fuel - main system												4400.1431	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5632.2751	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4400.1431	3.4800	153.1250	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.5065	3.4800	67.6688	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			246.8316	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7111	(257)
SAP value		90.0797	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4400.1431	0.2160	950.4309	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.5065	0.2160	420.0134	(264)
Space and water heating			1370.4443	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			1000.7220	(272)
CO2 emissions per m2			9.9300	(273)
EI value			90.8014	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.4274	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4488	0.4167	0.4274	0.4061	0.4061	0.3954	0.3847	0.3740	0.3633	0.3954	0.3740	0.3954	(22b)
Effective ac	0.6007	0.5868	0.5913	0.5824	0.5824	0.5782	0.5740	0.5699	0.5660	0.5782	0.5699	0.5782	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6432	50.4506	50.8383	50.0726	50.0726	49.7045	49.3462	48.9977	48.6591	49.7045	48.9977	49.7045	(38)
Heat transfer coeff	129.6023	128.4096	128.7974	128.0317	128.0317	127.6636	127.3053	126.9568	126.6181	127.6636	126.9568	127.6636	(39)
Average = Sum(39)m / 12 =												127.8084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2860	1.2742	1.2780	1.2704	1.2704	1.2668	1.2632	1.2597	1.2564	1.2668	1.2597	1.2668	(40)
HLP (average)												1.2682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5055	34.8260	34.7212	34.9288	34.9288	35.0296	35.1281	35.2246	35.3188	35.0296	35.2246	35.0296	
alpha	3.3004	3.3217	3.3147	3.3286	3.3286	3.3353	3.3419	3.3483	3.3546	3.3353	3.3483	3.3353	
util living area													
	0.9734	0.9630	0.9353	0.8728	0.7628	0.5805	0.4412	0.4619	0.7017	0.8867	0.9555	0.9768	(86)
MIT	19.3533	19.5238	19.8770	20.3237	20.6902	20.9119	20.9737	20.9700	20.8284	20.4008	19.8423	19.3486	(87)
Th 2	19.8518	19.8611	19.8581	19.8641	19.8641	19.8670	19.8698	19.8725	19.8752	19.8670	19.8725	19.8670	(88)
util rest of house													
	0.9674	0.9549	0.9205	0.8426	0.7044	0.4855	0.3218	0.3384	0.6157	0.8524	0.9438	0.9715	(89)
MIT 2	17.7059	17.9565	18.4587	19.0830	19.5602	19.8064	19.8592	19.8603	19.7377	19.2036	18.4259	17.7092	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9925	18.2292	18.7054	19.2988	19.7567	19.9987	20.0530	20.0533	19.9274	19.4119	18.6722	17.9943	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8425	18.0792	18.5554	19.1488	19.6067	19.8487	19.9030	19.9033	19.7774	19.2619	18.5222	17.8443	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8194	0.6893	0.4838	0.3254	0.3419	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2778	825.4071	877.7947	880.5145	762.0869	548.5204	350.8605	349.0188	573.3412	703.6390	726.1703	724.2091	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1677.3765	1640.9663	1488.3027	1235.3485	909.8883	580.7047	356.8407	355.8970	642.8886	1003.6760	1348.5651	1639.7550	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	680.0894	548.0558	454.2179	255.4804	109.9643	0.0000	0.0000	0.0000	0.0000	223.2275	448.1243	681.1661	(98)
Space heating												3400.3258	(98)
Space heating per m2											(98) / (4) =	33.7401	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3757.2660	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	680.0894	548.0558	454.2179	255.4804	109.9643	0.0000	0.0000	0.0000	0.0000	223.2275	448.1243	681.1661	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	751.4800	605.5865	501.8983	282.2988	121.5075	0.0000	0.0000	0.0000	0.0000	246.6602	495.1649	752.6697	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8221	89.7759	89.6421	89.3342	88.6994	87.3000	87.3000	87.3000	87.3000	89.2039	89.6422	89.8385	(217)
Fuel for water heating, kWh/month													
	196.3291	172.2376	179.0418	158.0992	153.8803	136.5557	128.1658	144.7599	145.8047	164.3328	176.6046	190.5826	(219)
Water heating fuel used												1946.3942	(219)
Annual totals kWh/year													
Space heating fuel - main system												3757.2660	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4840.8656	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3757.2660	10.2300	384.3683	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.3942	10.2300	199.1161	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			369.6663	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3757.2660	0.2160	811.5695	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.3942	0.2160	420.4211	(264)
Space and water heating			1231.9906	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			784.2002	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3757.2660	1.2200	4583.8646	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.3942	1.2200	2374.6009	(264)
Space and water heating			6958.4654	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			4309.6861	(272)
Primary energy kWh/m2/year			42.7633	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (24.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 91	A 93
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£186	£204	-£18
Mains gas	£686	£583	£104
Space heating	£515	£515	£0
Water heating	£199	£114	£85
Lighting	£158	£158	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£369	£284	£86
Total cost of uses	£369	£284	£85
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	32 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							5 * 10 =		50.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.4274	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5450	0.5343	0.5236	0.4702	0.4595	0.4061	0.4061	0.3954	0.4274	0.4595	0.4809	0.5022	(22b)
Effective ac	0.6485	0.6427	0.6371	0.6105	0.6056	0.5824	0.5824	0.5782	0.5913	0.6056	0.6156	0.6261	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16099.1940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.7459	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.8972	(36)
Total fabric heat loss	(33) + (36) = 77.9591	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.7514	55.2557	54.7698	52.4875	52.0604	50.0726	50.0726	49.7045	50.8383	52.0604	52.9243	53.8274	(38)
Heat transfer coeff	133.7105	133.2147	132.7288	130.4465	130.0195	128.0317	128.0317	127.6636	128.7974	130.0195	130.8833	131.7865	(39)
Average = Sum(39)m / 12 =												130.4445	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3268	1.3218	1.3170	1.2944	1.2901	1.2704	1.2704	1.2668	1.2780	1.2901	1.2987	1.3077	(40)
HLP (average)												1.2943	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.4454	33.5698	33.6927	34.2822	34.3948	34.9288	34.9288	35.0296	34.7212	34.3948	34.1678	33.9337	
alpha	3.2297	3.2380	3.2462	3.2855	3.2930	3.3286	3.3286	3.3353	3.3147	3.2930	3.2779	3.2622	
util living area													
	0.9788	0.9676	0.9459	0.8974	0.8070	0.6621	0.5181	0.5628	0.7673	0.9167	0.9674	0.9818	(86)
MIT	19.1530	19.3684	19.7186	20.1813	20.5793	20.8514	20.9513	20.9352	20.7410	20.2320	19.6221	19.1243	(87)
Th 2	19.8199	19.8238	19.8275	19.8452	19.8486	19.8641	19.8641	19.8670	19.8581	19.8486	19.8418	19.8348	(88)
util rest of house													
	0.9741	0.9605	0.9335	0.8726	0.7581	0.5761	0.3995	0.4446	0.6935	0.8913	0.9590	0.9778	(89)
MIT 2	17.3965	17.7094	18.2142	18.8764	19.4106	19.7469	19.8397	19.8316	19.6292	18.9619	18.0911	17.3642	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7020	17.9980	18.4759	19.1034	19.6139	19.9390	20.0330	20.0236	19.8226	19.1828	18.3574	17.6704	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5520	17.8480	18.3259	18.9534	19.4639	19.7890	19.8830	19.8736	19.6726	19.0328	18.2074	17.5204	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9433	0.9119	0.8485	0.7389	0.5698	0.4016	0.4453	0.6795	0.8676	0.9418	0.9657	(94)
Useful gains	738.8537	817.7261	867.8002	876.9319	801.2080	604.0217	406.8799	424.2507	605.3823	702.4941	703.5124	706.1100	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1771.9366	1724.8579	1569.6357	1311.4261	1009.4606	664.3534	420.3337	443.4487	717.7379	1096.4282	1453.7768	1755.4441	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	768.6137	609.5926	522.1656	312.8358	154.9400	0.0000	0.0000	0.0000	0.0000	293.0869	540.1904	780.7046	(98)
Space heating												3982.1295	(98)
Space heating per m2											(98) / (4) =	39.5131	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4400.1431	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	768.6137	609.5926	522.1656	312.8358	154.9400	0.0000	0.0000	0.0000	0.0000	293.0869	540.1904	780.7046	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	849.2969	673.5830	576.9785	345.6749	171.2044	0.0000	0.0000	0.0000	0.0000	323.8530	596.8955	862.6570	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9582	89.9859	90.0203	90.0833	90.1590	87.3000	87.3000	87.3000	87.3000	89.7092	89.8674	89.9682	(217)
Fuel for water heating, kWh/month	167.9983	125.0697	98.6725	50.1566	19.7699	2.9152	0.0000	29.5406	55.5649	103.4389	142.8765	166.8511	(219)
Water heating fuel used												962.8544	(219)
Annual totals kWh/year													
Space heating fuel - main system												4400.1431	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4700.6231	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4400.1431	3.4800	153.1250	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.8544	3.4800	33.5073	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			219.2651	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6317	(257)
SAP value	91.1876	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4400.1431	0.2160	950.4309	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.8544	0.2160	207.9766	(264)
Space and water heating			1158.4075	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			814.6351	(272)
CO2 emissions per m2			8.0800	(273)
EI value			92.5119	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.4274	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4274	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4488	0.4167	0.4274	0.4061	0.4061	0.3954	0.3847	0.3740	0.3633	0.3954	0.3740	0.3954	(22b)
Effective ac	0.6007	0.5868	0.5913	0.5824	0.5824	0.5782	0.5740	0.5699	0.5660	0.5782	0.5699	0.5782	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.6432	50.4506	50.8383	50.0726	50.0726	49.7045	49.3462	48.9977	48.6591	49.7045	48.9977	49.7045	(38)
Heat transfer coeff	129.6023	128.4096	128.7974	128.0317	128.0317	127.6636	127.3053	126.9568	126.6181	127.6636	126.9568	127.6636	(39)
Average = Sum(39)m / 12 =												127.8084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2860	1.2742	1.2780	1.2704	1.2704	1.2668	1.2632	1.2597	1.2564	1.2668	1.2597	1.2668	(40)
HLP (average)												1.2682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	14.6176	0.4600	0.0000	0.7700	32.9294	(75)
Southwest	5.0200	45.1778	0.4600	0.0000	0.7700	80.3300	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	166.5459	251.0749	372.3777	508.3464	579.1299	642.4538	607.1635	540.4181	441.4551	306.8857	200.8785	138.8103	(83)
Total gains	801.4373	880.8300	977.1772	1074.5342	1105.6526	1133.7575	1078.1541	1020.7135	944.2292	848.4987	785.5275	756.1437	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5055	34.8260	34.7212	34.9288	34.9288	35.0296	35.1281	35.2246	35.3188	35.0296	35.2246	35.0296	
alpha	3.3004	3.3217	3.3147	3.3286	3.3286	3.3353	3.3419	3.3483	3.3546	3.3353	3.3483	3.3353	
util living area													
	0.9734	0.9630	0.9353	0.8728	0.7628	0.5805	0.4412	0.4619	0.7017	0.8867	0.9555	0.9768	(86)
MIT	19.3533	19.5238	19.8770	20.3237	20.6902	20.9119	20.9737	20.9700	20.8284	20.4008	19.8423	19.3486	(87)
Th 2	19.8518	19.8611	19.8581	19.8641	19.8641	19.8670	19.8698	19.8725	19.8752	19.8670	19.8725	19.8670	(88)
util rest of house													
	0.9674	0.9549	0.9205	0.8426	0.7044	0.4855	0.3218	0.3384	0.6157	0.8524	0.9438	0.9715	(89)
MIT 2	17.7059	17.9565	18.4587	19.0830	19.5602	19.8064	19.8592	19.8603	19.7377	19.2036	18.4259	17.7092	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9925	18.2292	18.7054	19.2988	19.7567	19.9987	20.0530	20.0533	19.9274	19.4119	18.6722	17.9943	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8425	18.0792	18.5554	19.1488	19.6067	19.8487	19.9030	19.9033	19.7774	19.2619	18.5222	17.8443	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9371	0.8983	0.8194	0.6893	0.4838	0.3254	0.3419	0.6072	0.8293	0.9244	0.9578	(94)
Useful gains	763.2778	825.4071	877.7947	880.5145	762.0869	548.5204	350.8605	349.0188	573.3412	703.6390	726.1703	724.2091	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1677.3765	1640.9663	1488.3027	1235.3485	909.8883	580.7047	356.8407	355.8970	642.8886	1003.6760	1348.5651	1639.7550	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	680.0894	548.0558	454.2179	255.4804	109.9643	0.0000	0.0000	0.0000	0.0000	223.2275	448.1243	681.1661	(98)
Space heating												3400.3258	(98)
Space heating per m2											(98) / (4) =	33.7401	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3757.2660	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	680.0894	548.0558	454.2179	255.4804	109.9643	0.0000	0.0000	0.0000	0.0000	223.2275	448.1243	681.1661	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	751.4800	605.5865	501.8983	282.2988	121.5075	0.0000	0.0000	0.0000	0.0000	246.6602	495.1649	752.6697	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9148	89.9379	89.9630	90.0162	89.9471	87.3000	87.3000	87.3000	87.3000	89.5667	89.7894	89.9152	(217)
Fuel for water heating, kWh/month	163.2947	125.2544	98.2060	48.7609	24.6306	0.0000	0.0000	22.1819	49.8346	98.9959	137.4294	163.4229	(219)
Water heating fuel used												932.0114	(219)

Annual totals kWh/year		
Space heating fuel - main system	3757.2660	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =	-1368.9771	-1368.9771 (233)
Total delivered energy for all uses	3876.4829	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3757.2660	10.2300	384.3683	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	932.0114	10.2300	95.3448	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			284.2549	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3757.2660	0.2160	811.5695	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0114	0.2160	201.3145	(264)
Space and water heating			1012.8839	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			591.0435 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3757.2660	1.2200	4583.8646	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0114	1.2200	1137.0539	(264)
Space and water heating			5720.9185	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3225.6391	(272)
Primary energy kWh/m2/year			32.0067	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		77.96 (37)
Summer heat loss coefficient		421.84 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.3600	98.8453	0.4600	0.0000	0.9000	260.2635
South West	5.0200	119.9223	0.4600	0.0000	0.9000	249.2322
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						674.8231

	Jun	Jul	Aug	
Solar gains	716	675	600	(P4)
Internal gains	488	468	477	
Total summer gains	1204	1143	1077	(P5)
Summer gain/loss ratio	2.86	2.71	2.55	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.74	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-332.R	**Issued on Date**	06/07/2023
Assessment Reference	As Built	**Prop Type Ref**	Alston-As-DET
Property	24, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.03	**TER**	16.02
Environmental	90 B	**% DER<TER**	31.15		
CO_2 Emissions (t/year)	1.24	**DFEE**	49.07	**TFEE**	58.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.64		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 151 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.03 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.48 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.54 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 10.52 m², No overhang
Windows facing North East: 3.11 m², No overhang
Windows facing South East: 1.04 m², No overhang
Windows facing South: 19.04 m², No overhang
Windows facing North West: 2.07 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.036 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100 (1b)	x	2.5400 (2b)	=	195.0974	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1281	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3521	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4489	0.4401	0.4313	0.3873	0.3785	0.3345	0.3345	0.3257	0.3521	0.3785	0.3961	0.4137	(22b)
Effective ac	0.6008	0.5969	0.5930	0.5750	0.5716	0.5559	0.5559	0.5530	0.5620	0.5716	0.5785	0.5856	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3735	76.8695	76.3755	74.0552	73.6210	71.6001	71.6001	71.2258	72.3785	73.6210	74.4993	75.4174	(38)
Heat transfer coeff	200.8218	200.3178	199.8238	197.5034	197.0693	195.0483	195.0483	194.6741	195.8268	197.0693	197.9475	198.8657	(39)
Average = Sum(39)m / 12 =												197.5013	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3298	1.3264	1.3232	1.3078	1.3049	1.2915	1.2915	1.2891	1.2967	1.3049	1.3107	1.3168	(40)
HLP (average)												1.3078	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6735	25.4676	20.7116	15.6800	11.7210	9.8954	10.6923	13.8983	18.6542	23.6858	27.6448	29.4705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	548.8371	546.5681	528.4165	498.7028	467.7422	438.4787	419.8185	426.4341	441.9978	471.9488	506.4302	533.0523	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	938.0087	1203.8840	1422.3563	1612.6131	1732.2709	1704.2492	1635.6151	1526.3090	1410.5228	1196.0502	971.3224	867.0315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.1865	29.2600	29.3323	29.6769	29.7423	30.0505	30.0505	30.1082	29.9310	29.7423	29.6103	29.4736	
alpha	2.9458	2.9507	2.9555	2.9785	2.9828	3.0034	3.0034	3.0072	2.9954	2.9828	2.9740	2.9649	
util living area													
	0.9830	0.9651	0.9339	0.8726	0.7696	0.6245	0.4858	0.5314	0.7334	0.9054	0.9703	0.9864	(86)
MIT	18.7893	19.1225	19.5709	20.1014	20.5428	20.8310	20.9416	20.9224	20.7095	20.1153	19.3470	18.7323	(87)
Th 2	19.8176	19.8202	19.8227	19.8347	19.8370	19.8475	19.8475	19.8494	19.8434	19.8370	19.8324	19.8277	(88)
util rest of house													
	0.9795	0.9580	0.9203	0.8456	0.7193	0.5409	0.3732	0.4183	0.6596	0.8794	0.9631	0.9835	(89)
MIT 2	16.8914	17.3740	18.0176	18.7685	19.3578	19.7108	19.8165	19.8049	19.5824	18.8068	17.7113	16.8145	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.1057	17.5714	18.1930	18.9189	19.4916	19.8373	19.9436	19.9311	19.7097	18.9545	17.8960	17.0310	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9557	17.4214	18.0430	18.7689	19.3416	19.6873	19.7936	19.7811	19.5597	18.8045	17.7460	16.8810	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9369	0.8922	0.8146	0.6943	0.5281	0.3676	0.4110	0.6385	0.8485	0.9435	0.9719	(94)
Useful gains	905.9767	1127.9284	1269.0701	1313.6358	1202.7712	900.0113	601.2103	627.3019	900.6213	1014.8478	916.4805	842.6734	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2541.5379	2508.2589	2306.5639	1949.1484	1505.9166	992.2613	622.8986	658.2050	1069.1500	1616.8563	2107.3429	2521.8178	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1216.8575	927.5820	771.8953	457.5691	225.5402	0.0000	0.0000	0.0000	0.0000	447.8943	857.4209	1249.2835	(98)
Space heating												6154.0429	(98)
Space heating per m2											(98) / (4) =	40.7499	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6792.5418	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1216.8575	927.5820	771.8953	457.5691	225.5402	0.0000	0.0000	0.0000	0.0000	447.8943	857.4209	1249.2835	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1343.1099	1023.8212	851.9816	505.0432	248.9406	0.0000	0.0000	0.0000	0.0000	494.3645	946.3807	1378.9001	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7895	88.5611	88.1511	87.2886	85.5612	79.9000	79.9000	79.9000	79.9000	87.1552	88.3739	88.8650	(217)
Fuel for water heating, kWh/month													
	246.1675	217.4395	229.2024	207.1875	206.9091	197.6312	189.4714	208.3669	208.1424	215.1855	224.7805	239.9387	(219)
Water heating fuel used												2590.4226	(219)
Annual totals kWh/year													
Space heating fuel - main system												6792.5418	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												8686.1909	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6792.5418	0.2160	1467.1890	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2590.4226	0.2160	559.5313	(264)
Space and water heating			2026.7203	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1665.0949	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.0300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.0300	ZC1
Total Floor Area	TFA	151.0200	
Assumed number of occupants	N	2.9358	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6203	ZC2
CO2 emissions from cooking, equation (L16)		1.2545	ZC3
Total CO2 emissions		24.9048	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		24.9048	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1025	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3525	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3525	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4494	0.4406	0.4318	0.3877	0.3789	0.3349	0.3349	0.3261	0.3525	0.3789	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5932	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5786	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			33.5100	1.3258	44.4261			(27)
GF B&B J150 P/A=0.50			76.8100	0.1300	9.9853			(28a)
EW Brick AAC015	197.1500	37.7700	159.3800	0.1800	28.6884			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	3.5400		3.5400	0.1300	0.4602			(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		97.8933			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3252	(36)
Total fabric heat loss					(33) + (36) =		115.2185	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.4013	76.8962	76.4012	74.0758	73.6408	71.6155	71.6155	71.2405	72.3956	73.6408	74.5209	75.4410	(38)
Heat transfer coeff	192.6198	192.1148	191.6197	189.2944	188.8593	186.8340	186.8340	186.4590	187.6141	188.8593	189.7394	190.6596	(39)
Average = Sum(39)m / 12 =												189.2923	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2721	1.2688	1.2534	1.2506	1.2371	1.2371	1.2347	1.2423	1.2506	1.2564	1.2625	(40)
HLP (average)												1.2534	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9358	(42)
Average daily hot water use (litres/day)												103.9245	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (56)
If cylinder contains dedicated solar storage
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
221.2753 195.0098 204.7489 183.4685 179.7385 160.5247 154.0923 169.1898 168.9232 190.2499 201.2646 215.9261 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
221.2753 195.0098 204.7489 183.4685 179.7385 160.5247 154.0923 169.1898 168.9232 190.2499 201.2646 215.9261 (64)
Total per year (kWh/year) = Sum(64)m = 2244.4115 (64)
Heat gains from water heating, kWh/month
97.7656 86.6912 92.2705 84.4144 83.9546 76.7856 75.4272 80.4471 79.5781 87.4496 90.3316 95.9870 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6765	25.4703	20.7138	15.6817	11.7222	9.8964	10.6934	13.8997	18.6562	23.6883	27.6477	29.4736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	131.4053	129.0047	124.0195	117.2423	112.8422	106.6467	101.3807	108.1279	110.5252	117.5398	125.4606	129.0147	(72)
Total internal gains													
	551.7483	549.4789	531.3268	501.6126	470.6516	441.3879	422.7277	429.3437	444.9079	474.8595	509.3413	535.9635	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
Northeast	2.9100	11.2829	0.6300	0.7000	0.7700	10.0343	(75)
Southeast	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(77)
South	17.8400	46.7521	0.6300	0.7000	0.7700	254.8986	(78)
Northwest	1.9400	11.2829	0.6300	0.7000	0.7700	6.6895	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	314.5394	531.2513	722.4673	900.2005	1021.8838	1022.8711	982.4938	888.8431	782.7312	585.2209	375.7371	269.9326	(83)
Total gains	866.2877	1080.7301	1253.7942	1401.8131	1492.5354	1464.2590	1405.2215	1318.1868	1227.6391	1060.0804	885.0784	805.8961	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.4466	54.5898	54.7308	55.4031	55.5308	56.1327	56.1327	56.2456	55.8993	55.5308	55.2732	55.0064	
alpha	4.6298	4.6393	4.6487	4.6935	4.7021	4.7422	4.7422	4.7497	4.7266	4.7021	4.6849	4.6671	
util living area													
	0.9983	0.9950	0.9863	0.9588	0.8845	0.7333	0.5650	0.6184	0.8465	0.9739	0.9960	0.9988	(86)
MIT	19.5701	19.7725	20.0614	20.4223	20.7335	20.9253	20.9828	20.9740	20.8439	20.4310	19.9288	19.5386	(87)
Th 2	19.8601	19.8627	19.8653	19.8775	19.8798	19.8904	19.8904	19.8924	19.8863	19.8798	19.8752	19.8703	(88)
util rest of house													
	0.9977	0.9933	0.9812	0.9426	0.8385	0.6370	0.4326	0.4851	0.7711	0.9606	0.9943	0.9984	(89)
MIT 2	17.9608	18.2580	18.6789	19.2011	19.6174	19.8405	19.8842	19.8818	19.7618	19.2230	18.4957	17.9218	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	18.1425	18.4290	18.8350	19.3390	19.7434	19.9630	20.0082	20.0051	19.8840	19.3594	18.6575	18.1044	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1425	18.4290	18.8350	19.3390	19.7434	19.9630	20.0082	20.0051	19.8840	19.3594	18.6575	18.1044	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9900	0.9747	0.9324	0.8318	0.6440	0.4473	0.4995	0.7709	0.9519	0.9914	0.9973	(94)
Useful gains	863.0718	1069.8838	1222.0157	1307.0896	1241.5086	942.9628	628.5247	658.4748	946.4004	1009.0705	877.5101	803.7289	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2666.3417	2599.1126	2363.6200	1976.0349	1519.0754	1001.9863	636.7720	672.2061	1085.1568	1654.2920	2192.9061	2650.9977	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1341.6328	1027.6418	849.3536	481.6406	206.5097	0.0000	0.0000	0.0000	0.0000	480.0448	947.0851	1374.3680	(98)
Space heating												6708.2764	(98)
Space heating per m2											(98) / (4) =	44.4198	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7174.6272	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1341.6328	1027.6418	849.3536	481.6406	206.5097	0.0000	0.0000	0.0000	0.0000	480.0448	947.0851	1374.3680	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1434.9014	1099.0821	908.3995	515.1236	220.8660	0.0000	0.0000	0.0000	0.0000	513.4169	1012.9253	1469.9123	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	221.2753	195.0098	204.7489	183.4685	179.7385	160.5247	154.0923	169.1898	168.9232	190.2499	201.2646	215.9261	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8140	88.6051	88.2028	87.2721	85.1848	79.8000	79.8000	79.8000	79.8000	87.1821	88.4221	88.8818	(217)
Fuel for water heating, kWh/month													
	249.1447	220.0887	232.1343	210.2259	210.9983	201.1587	193.0981	212.0172	211.6832	218.2214	227.6181	242.9362	(219)
Water heating fuel used												2629.3248	(219)
Annual totals kWh/year													
Space heating fuel - main system												7174.6272	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	506.4367	(232)
Total delivered energy for all uses	10385.3887	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7174.6272	0.2160	1549.7195	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2629.3248	0.2160	567.9341	(264)
Space and water heating			2117.6536	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.4367	0.5190	262.8407	(268)
Total CO2, kg/m2/year			2419.4193	(272)
Emissions per m2 for space and water heating			14.0223	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7404	(272b)
Emissions per m2 for pumps and fans			0.2577	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0223 * 1.00) + 1.7404 + 0.2577, rounded to 2 d.p.			16.0200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100 (1b)	x	2.5400 (2b)	=	195.0974	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1025	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3265	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3265	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4163	0.4081	0.4000	0.3591	0.3510	0.3102	0.3102	0.3020	0.3265	0.3510	0.3673	0.3836	(22b)
Effective ac	0.5866	0.5833	0.5800	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5675	0.5736	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.6185	(36)
Total fabric heat loss	(33) + (36) =	123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.5533	75.1200	74.6953	72.7003	72.3271	70.5895	70.5895	70.2678	71.2588	72.3271	73.0821	73.8715	(38)
Heat transfer coeff	199.0015	198.5682	198.1435	196.1486	195.7753	194.0378	194.0378	193.7160	194.7071	195.7753	196.5304	197.3198	(39)
Average = Sum(39)m / 12 =												196.1468	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3177	1.3148	1.3120	1.2988	1.2964	1.2848	1.2848	1.2827	1.2893	1.2964	1.3014	1.3066	(40)
HLP (average)												1.2988	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358	(42)
Average daily hot water use (litres/day)	103.9245	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0249	31.5076	32.5130	28.3456	27.1983	23.4701	21.7485	24.9567	25.2547	29.4320	32.1273	34.8882	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6735	25.4676	20.7116	15.6800	11.7210	9.8954	10.6923	13.8983	18.6542	23.6858	27.6448	29.4705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	48.4205	46.8863	43.7003	39.3689	36.5568	32.5973	29.2318	33.5439	35.0760	39.5591	44.6212	46.8927	(72)
Total internal gains													
	465.7605	464.3578	448.0054	420.7377	391.3650	364.3375	347.5778	351.7583	366.4568	393.8762	425.4990	450.8384	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	854.9320	1121.6737	1341.9451	1534.6479	1655.8937	1630.1080	1563.3743	1451.6333	1334.9819	1117.9776	890.3912	784.8176	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.4535	29.5178	29.5810	29.8819	29.9389	30.2070	30.2070	30.2571	30.1031	29.9389	29.8238	29.7045	
alpha	2.9636	2.9679	2.9721	2.9921	2.9959	3.0138	3.0138	3.0171	3.0069	2.9959	2.9883	2.9803	
util living area													
	0.9867	0.9705	0.9417	0.8837	0.7841	0.6415	0.5022	0.5506	0.7528	0.9177	0.9761	0.9895	(86)
MIT	18.7382	19.0756	19.5299	20.0676	20.5209	20.8196	20.9368	20.9154	20.6889	20.0734	19.2936	18.6779	(87)
Th 2	19.8270	19.8292	19.8314	19.8418	19.8437	19.8527	19.8527	19.8544	19.8492	19.8437	19.8398	19.8357	(88)
util rest of house													
	0.9838	0.9645	0.9295	0.8584	0.7354	0.5582	0.3876	0.4358	0.6810	0.8943	0.9702	0.9873	(89)
MIT 2	17.7759	18.1108	18.5578	19.0820	19.4982	19.7521	19.8296	19.8208	19.6560	19.1008	18.3375	17.7222	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.8846	18.2197	18.6676	19.1933	19.6137	19.8726	19.9546	19.9444	19.7726	19.2106	18.4454	17.8301	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8846	18.2197	18.6676	19.1933	19.6137	19.8726	19.9546	19.9444	19.7726	19.2106	18.4454	17.8301	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9772	0.9533	0.9139	0.8413	0.7243	0.5597	0.3985	0.4456	0.6755	0.8779	0.9603	0.9818	(94)
Useful gains	835.4476	1069.2818	1226.3699	1291.1734	1199.3274	912.4452	623.0026	646.8375	901.7873	981.5165	855.0567	770.5618	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2703.3519	2644.8787	2410.9292	2019.0080	1549.2987	1023.0846	650.9225	686.6030	1104.4956	1685.7365	2229.7228	2689.4857	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1389.7207	1058.8012	881.3121	524.0409	260.3786	0.0000	0.0000	0.0000	0.0000	523.9397	989.7596	1427.6794	(98)
Space heating												7055.6322	(98)
Space heating per m2											(98) / (4) =	46.7199	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1823.9552	1435.8797	1472.2418	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7897	0.8519	0.8246	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1440.4228	1223.1554	1214.0547	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2031.3844	1950.4193	1822.2721	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	425.4923	541.0844	452.5137	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1419.0904	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	106.3731	135.2711	113.1284	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												354.7726	(107)
Space cooling per m2												2.3492	(108)
Energy for space heating												46.7199	(99)
Energy for space cooling												2.3492	(108)
Total												49.0690	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1025	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3525	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3525	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4494	0.4406	0.4318	0.3877	0.3789	0.3349	0.3349	0.3261	0.3525	0.3789	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5932	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5786	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			33.5100	1.3258	44.4261			(27)
GF B&B J150 P/A=0.50			76.8100	0.1300	9.9853			(28a)
EW Brick AAC015	197.1500	37.7700	159.3800	0.1800	28.6884			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	3.5400		3.5400	0.1300	0.4602			(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		97.8933			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3252	(36)
Total fabric heat loss					(33) + (36) =		115.2185	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.4013	76.8962	76.4012	74.0758	73.6408	71.6155	71.6155	71.2405	72.3956	73.6408	74.5209	75.4410	(38)
Heat transfer coeff	192.6198	192.1148	191.6197	189.2944	188.8593	186.8340	186.8340	186.4590	187.6141	188.8593	189.7394	190.6596	(39)
Average = Sum(39)m / 12 =												189.2923	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2721	1.2688	1.2534	1.2506	1.2371	1.2371	1.2347	1.2423	1.2506	1.2564	1.2625	(40)
HLP (average)												1.2534	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358	(42)
Average daily hot water use (litres/day)	103.9245	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0249	31.5076	32.5130	28.3456	27.1983	23.4701	21.7485	24.9567	25.2547	29.4320	32.1273	34.8882	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6765	25.4703	20.7138	15.6817	11.7222	9.8964	10.6934	13.8997	18.6562	23.6883	27.6477	29.4736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	48.4205	46.8863	43.7003	39.3689	36.5568	32.5973	29.2318	33.5439	35.0760	39.5591	44.6212	46.8927	(72)
Total internal gains													
	465.7635	464.3604	448.0076	420.7393	391.3662	364.3385	347.5789	351.7598	366.4588	393.8787	425.5019	450.8415	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
Northeast	2.9100	11.2829	0.6300	0.7000	0.7700	10.0343	(75)
Southeast	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(77)
South	17.8400	46.7521	0.6300	0.7000	0.7700	254.8986	(78)
Northwest	1.9400	11.2829	0.6300	0.7000	0.7700	6.6895	(81)

Solar gains	314.5394	531.2513	722.4673	900.2005	1021.8838	1022.8711	982.4938	888.8431	782.7312	585.2209	375.7371	269.9326	(83)
Total gains	780.3028	995.6117	1170.4749	1320.9398	1413.2500	1387.2097	1330.0726	1240.6029	1149.1900	979.0997	801.2390	720.7740	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.4466	54.5898	54.7308	55.4031	55.5308	56.1327	56.1327	56.2456	55.8993	55.5308	55.2732	55.0064	
alpha	4.6298	4.6393	4.6487	4.6935	4.7021	4.7422	4.7422	4.7497	4.7266	4.7021	4.6849	4.6671	
util living area													
	0.9989	0.9965	0.9895	0.9666	0.9010	0.7595	0.5923	0.6494	0.8707	0.9806	0.9974	0.9993	(86)
MIT	19.5182	19.7219	20.0137	20.3813	20.7050	20.9129	20.9791	20.9681	20.8202	20.3869	19.8786	19.4870	(87)
Th 2	19.8601	19.8627	19.8653	19.8775	19.8798	19.8904	19.8904	19.8924	19.8863	19.8798	19.8752	19.8703	(88)
util rest of house													
	0.9985	0.9952	0.9856	0.9530	0.8592	0.6646	0.4557	0.5129	0.8011	0.9704	0.9962	0.9990	(89)
MIT 2	18.5116	18.7168	19.0086	19.3775	19.6779	19.8497	19.8851	19.8833	19.7854	19.3897	18.8834	18.4885	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	18.6252	18.8303	19.1221	19.4908	19.7939	19.9698	20.0086	20.0057	19.9022	19.5023	18.9957	18.6012	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6252	18.8303	19.1221	19.4908	19.7939	19.9698	20.0086	20.0057	19.9022	19.5023	18.9957	18.6012	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9936	0.9820	0.9469	0.8553	0.6722	0.4711	0.5280	0.8023	0.9656	0.9949	0.9986	(94)
Useful gains	778.6860	989.2229	1149.4369	1250.8328	1208.8076	932.5235	626.5991	655.0322	921.9841	945.3782	797.1901	719.7392	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2759.3230	2676.2091	2418.6379	2004.7841	1528.6024	1003.2543	636.8478	672.3243	1088.5781	1681.2770	2257.0895	2745.7241	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1473.5939	1133.6547	944.2855	542.8449	237.9273	0.0000	0.0000	0.0000	0.0000	547.5087	1051.1276	1507.3327	(98)
Space heating												7438.2755	(98)
Space heating per m2											(98) / (4) =	49.2536	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1756.2400	1382.5719	1417.0883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8238	0.8952	0.8668	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1446.7529	1237.7211	1228.3419	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1747.4786	1677.7305	1575.6152	0.0000	0.0000	0.0000	0.0000	(103)

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Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	216.5225	327.3670	258.3713	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												802.2608 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	54.1306	81.8417	64.5928	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												200.5652 (107)
Space cooling per m2												1.3281 (108)
Energy for space heating												49.2536 (99)
Energy for space cooling												1.3281 (108)
Total												50.5816 (109)
Target Fabric Energy Efficiency (TFEE)												58.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3521	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3697	0.3433	0.3521	0.3345	0.3345	0.3257	0.3169	0.3081	0.2993	0.3257	0.3081	0.3257	(22b)
Effective ac	0.5683	0.5589	0.5620	0.5559	0.5559	0.5530	0.5502	0.5475	0.5448	0.5530	0.5475	0.5530	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.1969	71.9843	72.3785	71.6001	71.6001	71.2258	70.8616	70.5073	70.1630	71.2258	70.5073	71.2258	(38)
Heat transfer coeff	196.6451	195.4326	195.8268	195.0483	195.0483	194.6741	194.3098	193.9555	193.6112	194.6741	193.9555	194.6741	(39)
Average = Sum(39)m / 12 =												194.8213	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3021	1.2941	1.2967	1.2915	1.2915	1.2891	1.2866	1.2843	1.2820	1.2891	1.2843	1.2891	(40)
HLP (average)												1.2900	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358	(42)
Average daily hot water use (litres/day)	103.9245	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.5671	(64)
RHI water heating demand												2213	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	13.4839	0.4600	0.0000	0.7700	50.2435	(74)
Northeast	3.1100	14.6176	0.4600	0.0000	0.7700	16.1022	(75)
Southeast	1.0400	45.1778	0.4600	0.0000	0.7700	16.6421	(77)
South	9.5500	56.7559	0.4600	0.0000	0.7700	191.9829	(78)
Northwest	2.0700	14.6176	0.4600	0.0000	0.7700	10.7176	(81)
South	9.4900	56.7559	0.4600	0.0000	0.7700	190.7768	(78)

Solar gains	476.4651	685.2163	943.2742	1193.3479	1298.2433	1416.5913	1347.9838	1241.2720	1082.8237	815.2016	567.2938	402.0133	(83)
Total gains	1273.9565	1477.2735	1705.9035	1909.8973	1966.7614	2042.6449	1949.5828	1852.6518	1721.0435	1499.7387	1303.3829	1177.9256	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8064	29.9914	29.9310	30.0505	30.0505	30.1082	30.1647	30.2198	30.2735	30.1082	30.2198	30.1082	
alpha	2.9871	2.9994	2.9954	3.0034	3.0034	3.0072	3.0110	3.0147	3.0182	3.0072	3.0147	3.0072	
util living area													
	0.9595	0.9388	0.8927	0.8069	0.6830	0.4999	0.3746	0.3916	0.6113	0.8261	0.9301	0.9659	(86)
MIT	19.2199	19.4567	19.8821	20.3553	20.7110	20.9186	20.9747	20.9715	20.8455	20.4210	19.7774	19.1829	(87)
Th 2	19.8392	19.8455	19.8434	19.8475	19.8475	19.8494	19.8513	19.8531	19.8549	19.8494	19.8531	19.8494	(88)
util rest of house													
	0.9516	0.9273	0.8724	0.7705	0.6223	0.4130	0.2701	0.2834	0.5269	0.7840	0.9144	0.9590	(89)
MIT 2	17.5246	17.8654	18.4639	19.1121	19.5660	19.7927	19.8406	19.8410	19.7320	19.2179	18.3346	17.4787	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.7160	18.0451	18.6240	19.2524	19.6953	19.9198	19.9687	19.9687	19.8577	19.3537	18.4975	17.6711	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5660	17.8951	18.4740	19.1024	19.5453	19.7698	19.8187	19.8187	19.7077	19.2037	18.3475	17.5211	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9292	0.9006	0.8419	0.7428	0.6046	0.4066	0.2671	0.2800	0.5150	0.7553	0.8863	0.9387	(94)
Useful gains	1183.7253	1330.5041	1436.1965	1418.7345	1189.0554	830.4835	520.6682	518.7046	886.3535	1132.6958	1155.2341	1105.6734	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	2490.7012	2461.4908	2246.9125	1872.9374	1374.1757	870.1575	528.2611	527.2985	969.5468	1519.1804	2026.3506	2437.5277 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	972.3901	760.0231	603.1726	327.0261	137.7295	0.0000	0.0000	0.0000	0.0000	287.5446	627.2039	990.8996 (98)
Space heating												4705.9894 (98)
RHI space heating demand												4706 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100 (1b)	x	2.5400 (2b)	=	195.0974	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1281	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3521	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4489	0.4401	0.4313	0.3873	0.3785	0.3345	0.3345	0.3257	0.3521	0.3785	0.3961	0.4137	(22b)
Effective ac	0.6008	0.5969	0.5930	0.5750	0.5716	0.5559	0.5559	0.5530	0.5620	0.5716	0.5785	0.5856	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3735	76.8695	76.3755	74.0552	73.6210	71.6001	71.6001	71.2258	72.3785	73.6210	74.4993	75.4174	(38)
Heat transfer coeff	200.8218	200.3178	199.8238	197.5034	197.0693	195.0483	195.0483	194.6741	195.8268	197.0693	197.9475	198.8657	(39)
Average = Sum(39)m / 12 =												197.5013	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3298	1.3264	1.3232	1.3078	1.3049	1.2915	1.2915	1.2891	1.2967	1.3049	1.3107	1.3168	(40)
HLP (average)												1.3078	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	1186.6629	1449.3732	1656.5690	1830.4598	1933.0469	1891.8241	1817.3956	1711.2547	1606.7449	1408.6384	1200.9813	1109.8915	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.1865	29.2600	29.3323	29.6769	29.7423	30.0505	30.0505	30.1082	29.9310	29.7423	29.6103	29.4736	
alpha	2.9458	2.9507	2.9555	2.9785	2.9828	3.0034	3.0034	3.0072	2.9954	2.9828	2.9740	2.9649	
util living area													
	0.9692	0.9457	0.9079	0.8382	0.7286	0.5804	0.4447	0.4848	0.6816	0.8682	0.9503	0.9742	(86)
MIT	18.9966	19.3126	19.7308	20.2177	20.6117	20.8620	20.9540	20.9395	20.7651	20.2436	19.5286	18.9385	(87)
Th 2	19.8176	19.8202	19.8227	19.8347	19.8370	19.8475	19.8475	19.8494	19.8434	19.8370	19.8324	19.8277	(88)
util rest of house													
	0.9632	0.9354	0.8902	0.8068	0.6753	0.4981	0.3388	0.3778	0.6050	0.8355	0.9391	0.9691	(89)
MIT 2	17.1899	17.6438	18.2388	18.9201	19.4373	19.7383	19.8237	19.8157	19.6384	18.9745	17.9687	17.1123	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.3939	17.8322	18.4072	19.0666	19.5699	19.8651	19.9513	19.9425	19.7656	19.1178	18.1448	17.3185	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2439	17.6822	18.2572	18.9166	19.4199	19.7151	19.8013	19.7925	19.6156	18.9678	17.9948	17.1685	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9435	0.9095	0.8598	0.7769	0.6536	0.4878	0.3343	0.3721	0.5879	0.8045	0.9139	0.9515	(94)
Useful gains	1119.6002	1318.2013	1424.3212	1422.1523	1263.3556	922.9107	607.6134	636.7637	944.6486	1133.2793	1097.5667	1056.0833	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2599.4197	2560.4999	2349.3694	1978.3165	1521.3469	997.6969	624.4103	660.4388	1080.0995	1649.0294	2156.5970	2578.9845	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1100.9857	834.8246	688.2359	400.4382	191.9456	0.0000	0.0000	0.0000	0.0000	383.7181	762.5018	1133.0385	(98)
Space heating												5495.6884	(98)
Space heating per m2											(98) / (4) =	36.3905	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6065.8813	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1100.9857	834.8246	688.2359	400.4382	191.9456	0.0000	0.0000	0.0000	0.0000	383.7181	762.5018	1133.0385	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1215.2160	921.4400	759.6423	441.9848	211.8605	0.0000	0.0000	0.0000	0.0000	423.5299	841.6135	1250.5944	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.6339	88.3816	87.9277	86.9762	85.1302	79.9000	79.9000	79.9000	79.9000	86.7845	88.1599	88.7183	(217)
Fuel for water heating, kWh/month													
	246.5994	217.8813	229.7846	207.9318	207.9568	197.6312	189.4714	208.3669	208.1424	216.1046	225.3259	240.3355	(219)
Water heating fuel used												2595.5319	(219)
Annual totals kWh/year													
Space heating fuel - main system												6065.8813	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												7964.6396	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6065.8813	3.4800	211.0927	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2595.5319	3.4800	90.3245	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	506.3836	13.1900	66.7920	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			329.5128	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7060	(257)
SAP value		90.1509	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6065.8813	0.2160	1310.2304	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2595.5319	0.2160	560.6349	(264)
Space and water heating			1870.8652	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			1509.2398	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	9.9900 (273)
EI value	89.6828
EI rating	90 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8503 = 4.093, stars = 4
Water heating environmental impact	0.216 / 0.8503 = 0.2540, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		50.0000 / (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3521	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3697	0.3433	0.3521	0.3345	0.3345	0.3257	0.3169	0.3081	0.2993	0.3257	0.3081	0.3257	(22b)
Effective ac	0.5683	0.5589	0.5620	0.5559	0.5559	0.5530	0.5502	0.5475	0.5448	0.5530	0.5475	0.5530	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21100.6530 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		139.7209 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.6185 (36)
Total fabric heat loss	(33) + (36) =	123.4482 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.1969	71.9843	72.3785	71.6001	71.6001	71.2258	70.8616	70.5073	70.1630	71.2258	70.5073	71.2258	(38)
Heat transfer coeff	196.6451	195.4326	195.8268	195.0483	195.0483	194.6741	194.3098	193.9555	193.6112	194.6741	193.9555	194.6741	(39)
Average = Sum(39)m / 12 =												194.8213	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3021	1.2941	1.2967	1.2915	1.2915	1.2891	1.2866	1.2843	1.2820	1.2891	1.2843	1.2891	(40)
HLP (average)												1.2900	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9358 (42)
Average daily hot water use (litres/day)		103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	13.4839	0.4600	0.0000	0.7700	50.2435	(74)
Northeast	3.1100	14.6176	0.4600	0.0000	0.7700	16.1022	(75)
Southeast	1.0400	45.1778	0.4600	0.0000	0.7700	16.6421	(77)
South	9.5500	56.7559	0.4600	0.0000	0.7700	191.9829	(78)
Northwest	2.0700	14.6176	0.4600	0.0000	0.7700	10.7176	(81)
South	9.4900	56.7559	0.4600	0.0000	0.7700	190.7768	(78)

Solar gains	476.4651	685.2163	943.2742	1193.3479	1298.2433	1416.5913	1347.9838	1241.2720	1082.8237	815.2016	567.2938	402.0133	(83)
Total gains	1273.9565	1477.2735	1705.9035	1909.8973	1966.7614	2042.6449	1949.5828	1852.6518	1721.0435	1499.7387	1303.3829	1177.9256	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8064	29.9914	29.9310	30.0505	30.0505	30.1082	30.1647	30.2198	30.2735	30.1082	30.2198	30.1082	
alpha	2.9871	2.9994	2.9954	3.0034	3.0034	3.0072	3.0110	3.0147	3.0182	3.0072	3.0147	3.0072	
util living area													
	0.9595	0.9388	0.8927	0.8069	0.6830	0.4999	0.3746	0.3916	0.6113	0.8261	0.9301	0.9659	(86)
MIT	19.2199	19.4567	19.8821	20.3553	20.7110	20.9186	20.9747	20.9715	20.8455	20.4210	19.7774	19.1829	(87)
Th 2	19.8392	19.8455	19.8434	19.8475	19.8475	19.8494	19.8513	19.8531	19.8549	19.8494	19.8531	19.8494	(88)
util rest of house													
	0.9516	0.9273	0.8724	0.7705	0.6223	0.4130	0.2701	0.2834	0.5269	0.7840	0.9144	0.9590	(89)
MIT 2	17.5246	17.8654	18.4639	19.1121	19.5660	19.7927	19.8406	19.8410	19.7320	19.2179	18.3346	17.4787	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.7160	18.0451	18.6240	19.2524	19.6953	19.9198	19.9687	19.9687	19.8577	19.3537	18.4975	17.6711	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5660	17.8951	18.4740	19.1024	19.5453	19.7698	19.8187	19.8187	19.7077	19.2037	18.3475	17.5211	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9292	0.9006	0.8419	0.7428	0.6046	0.4066	0.2671	0.2800	0.5150	0.7553	0.8863	0.9387	(94)
Useful gains	1183.7253	1330.5041	1436.1965	1418.7345	1189.0554	830.4835	520.6682	518.7046	886.3535	1132.6958	1155.2341	1105.6734	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2490.7012	2461.4908	2246.9125	1872.9374	1374.1757	870.1575	528.2611	527.2985	969.5468	1519.1804	2026.3506	2437.5277	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	972.3901	760.0231	603.1726	327.0261	137.7295	0.0000	0.0000	0.0000	0.0000	287.5446	627.2039	990.8996	(98)
Space heating												4705.9894	(98)
Space heating per m2											(98) / (4) =	31.1614	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5194.2488	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	972.3901	760.0231	603.1726	327.0261	137.7295	0.0000	0.0000	0.0000	0.0000	287.5446	627.2039	990.8996	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1073.2782	838.8775	665.7535	360.9560	152.0193	0.0000	0.0000	0.0000	0.0000	317.3782	692.2780	1093.7081	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4267	88.2120	87.6546	86.4762	84.2540	79.9000	79.9000	79.9000	79.9000	86.0509	87.7727	88.5013	(217)
Fuel for water heating, kWh/month	247.1773	218.3002	230.5005	209.1340	210.1193	197.6312	189.4714	208.3669	208.1424	217.9469	226.3201	240.9247	(219)
Water heating fuel used												2604.0351	(219)
Annual totals kWh/year													
Space heating fuel - main system												5194.2488	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												6949.2167	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5194.2488	10.2300	531.3717	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2604.0351	10.2300	266.3928	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	506.3836	36.7200	185.9441	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			588.9870	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5194.2488	0.2160	1121.9577	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.0351	0.2160	562.4716	(264)
Space and water heating			1684.4293	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			1243.7635	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5194.2488	1.2200	6336.9835	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.0351	1.2200	3176.9228	(264)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space and water heating			9513.9064 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	506.3836	3.0700	1554.5978 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	3.0700	-4391.4840 (269)
Primary energy kWh/year			6907.2701 (272)
Primary energy kWh/m2/year			45.7375 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 122	-270 kg (21.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£122	1.79 kg/m²	B 91	B 91
Total Savings	£122	1.79 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 522 TEST (30 Jun 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£213	£232	-£18
Mains gas	£901	£760	£140
Space heating	£662	£665	-£3
Water heating	£266	£141	£125
Lighting	£186	£186	£0
Generated (PV)	-£525	-£525	£0
Total cost of fuels	£589	£467	£122
Total cost of uses	£589	£467	£122
Delivered energy	46 kWh/m²	37 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.2 tonnes	1.0 tonnes	0.3 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	46 kWh/m²	36 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3521	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4489	0.4401	0.4313	0.3873	0.3785	0.3345	0.3345	0.3257	0.3521	0.3785	0.3961	0.4137	(22b)
Effective ac	0.6008	0.5969	0.5930	0.5750	0.5716	0.5559	0.5559	0.5530	0.5620	0.5716	0.5785	0.5856	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3735	76.8695	76.3755	74.0552	73.6210	71.6001	71.6001	71.2258	72.3785	73.6210	74.4993	75.4174	(38)
Heat transfer coeff	200.8218	200.3178	199.8238	197.5034	197.0693	195.0483	195.0483	194.6741	195.8268	197.0693	197.9475	198.8657	(39)
Average = Sum(39)m / 12 =												197.5013	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3298	1.3264	1.3232	1.3078	1.3049	1.2915	1.2915	1.2891	1.2967	1.3049	1.3107	1.3168	(40)
HLP (average)												1.3078	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.3637	184.2509	191.4416	165.1875	155.0326	136.3906	129.1537	145.1817	151.9929	176.9426	189.7372	204.0145	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1091	(H8)
Utilisation factor												0.5941	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.9245	(H14)
Volume ratio Veff/V												1.1114	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-947.3706	(H17)
Solar input	-27.4719	-45.8426	-78.0753	-104.6362	-129.2692	-127.0923	-125.4127	-109.5737	-85.8182	-58.6037	-32.5856	-22.9893	(63)
								Solar input (sum of months) = Sum(63)m =				-947.3706	(63)
Output from w/h													
	181.8919	138.4083	113.3663	60.5513	25.7634	9.2984	3.7411	35.6080	66.1748	118.3389	157.1516	181.0253	(64)
								Total per year (kWh/year) = Sum(64)m =				1091.3192	(64)
Heat gains from water heating, kWh/month													
	88.2363	78.0841	81.6247	69.7897	64.1899	57.4784	55.4764	61.2407	66.0339	76.8038	81.1098	86.4577	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	118.5972	116.1965	109.7106	96.9301	86.2767	79.8311	74.5650	82.3128	91.7138	103.2309	112.6524	116.2066	(72)
Total internal gains													
	787.5914	782.1572	751.2285	699.1455	644.8608	602.1461	577.6916	588.4728	622.3166	673.1362	726.1891	766.0123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	1176.7629	1439.4732	1645.1682	1813.0558	1909.3895	1867.9166	1793.4882	1688.3478	1590.8417	1397.2376	1191.0813	1099.9915	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.1865	29.2600	29.3323	29.6769	29.7423	30.0505	30.0505	30.1082	29.9310	29.7423	29.6103	29.4736	
alpha	2.9458	2.9507	2.9555	2.9785	2.9828	3.0034	3.0034	3.0072	2.9954	2.9828	2.9740	2.9649	
util living area													
	0.9698	0.9466	0.9092	0.8410	0.7334	0.5858	0.4497	0.4902	0.6856	0.8703	0.9512	0.9748	(86)
MIT	18.9886	19.3052	19.7234	20.2089	20.6042	20.8584	20.9526	20.9377	20.7611	20.2372	19.5211	18.9303	(87)
Th 2	19.8176	19.8202	19.8227	19.8347	19.8370	19.8475	19.8475	19.8494	19.8434	19.8370	19.8324	19.8277	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9639	0.9364	0.8918	0.8099	0.6803	0.5033	0.3430	0.3824	0.6092	0.8379	0.9402	0.9698	(89)
MIT 2	17.1784	17.6333	18.2286	18.9089	19.4287	19.7352	19.8229	19.8145	19.6344	18.9662	17.9581	17.1005	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.3828	17.8221	18.3973	19.0556	19.5615	19.8620	19.9504	19.9413	19.7616	19.1097	18.1345	17.3071	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2328	17.6721	18.2473	18.9056	19.4115	19.7120	19.8004	19.7913	19.6116	18.9597	17.9845	17.1571	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9445	0.9107	0.8614	0.7799	0.6582	0.4927	0.3384	0.3766	0.5918	0.8069	0.9152	0.9524	(94)
Useful gains	1111.3976	1310.8577	1417.1529	1414.0334	1256.7890	920.3116	606.8861	635.7580	941.4903	1127.3923	1090.1243	1047.6694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2597.1819	2558.4764	2347.3954	1976.1494	1519.6906	997.0846	624.2390	660.2023	1079.3232	1647.4402	2154.5634	2576.7143	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1105.4235	838.3998	692.1005	404.7235	195.5988	0.0000	0.0000	0.0000	0.0000	386.9156	766.3962	1137.6094	(98)
Space heating												5527.1674	(98)
Space heating per m2											(98) / (4) =	36.5989	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6100.6262	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1105.4235	838.3998	692.1005	404.7235	195.5988	0.0000	0.0000	0.0000	0.0000	386.9156	766.3962	1137.6094	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1220.1143	925.3861	763.9078	446.7147	215.8927	0.0000	0.0000	0.0000	0.0000	427.0592	845.9119	1255.6395	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	181.8919	138.4083	113.3663	60.5513	25.7634	9.2984	3.7411	35.6080	66.1748	118.3389	157.1516	181.0253	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9175	88.9128	88.9239	89.0481	89.2096	79.9000	79.9000	79.9000	79.9000	87.8447	88.5815	88.9644	(217)
Fuel for water heating, kWh/month													
	204.5625	155.6674	127.4868	67.9984	28.8796	11.6375	4.6822	44.5657	82.8220	134.7137	177.4092	203.4805	(219)
Water heating fuel used												1243.9056	(219)
Annual totals kWh/year													
Space heating fuel - main system												6100.6262	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												6697.7584	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6100.6262	3.4800	212.3018	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1243.9056	3.4800	43.2879	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	506.3836	13.1900	66.7920	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			290.2803	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6220 (257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	91.3236	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6100.6262	0.2160	1317.7353	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1243.9056	0.2160	268.6836	(264)
Space and water heating			1586.4189	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			1250.7434	(272)
CO2 emissions per m2			8.2800	(273)
EI value			91.4499	
EI rating			91	(274)
EI band			B	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3521	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3521	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3697	0.3433	0.3521	0.3345	0.3345	0.3257	0.3169	0.3081	0.2993	0.3257	0.3081	0.3257	(22b)
Effective ac	0.5683	0.5589	0.5620	0.5559	0.5559	0.5530	0.5502	0.5475	0.5448	0.5530	0.5475	0.5530	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.1969	71.9843	72.3785	71.6001	71.6001	71.2258	70.8616	70.5073	70.1630	71.2258	70.5073	71.2258	(38)
Heat transfer coeff	196.6451	195.4326	195.8268	195.0483	195.0483	194.6741	194.3098	193.9555	193.6112	194.6741	193.9555	194.6741	(39)
Average = Sum(39)m / 12 =												194.8213	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3021	1.2941	1.2967	1.2915	1.2915	1.2891	1.2866	1.2843	1.2820	1.2891	1.2843	1.2891	(40)
HLP (average)												1.2900	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358	(42)
Average daily hot water use (litres/day)	103.9245	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.3637	184.2509	191.4416	165.1875	155.0326	136.3906	129.1537	145.1817	151.9929	176.9426	189.7372	204.0145	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2413	(H8)
Utilisation factor												0.5532	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.9245	(H14)
Volume ratio Veff/V												1.1114	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-987.2650	(H17)
Solar input	-32.2070	-45.7963	-78.7128	-106.2018	-124.7404	-133.2424	-130.4403	-116.7480	-91.4056	-63.1947	-38.0924	-26.4835	(63)
								Solar input (sum of months) = Sum(63)m =				-987.2650	(63)
Output from w/h													
	177.1568	138.4547	112.7288	58.9858	30.2923	3.1482	0.0000	28.4337	60.5873	113.7479	151.6449	177.5310	(64)
									Total per year (kWh/year) = Sum(64)m =			1052.7113	(64)
Heat gains from water heating, kWh/month													
	88.2363	78.0841	81.6247	69.7897	64.1899	57.4784	55.4764	61.2407	66.0339	76.8038	81.1098	86.4577	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	118.5972	116.1965	109.7106	96.9301	86.2767	79.8311	74.5650	82.3128	91.7138	103.2309	112.6524	116.2066	(72)
Total internal gains													
	787.5914	782.1572	751.2285	699.1455	644.8608	602.1461	577.6916	588.4728	622.3166	673.1362	726.1891	766.0123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	13.4839	0.4600	0.0000	0.7700	50.2435	(74)
Northeast	3.1100	14.6176	0.4600	0.0000	0.7700	16.1022	(75)
Southeast	1.0400	45.1778	0.4600	0.0000	0.7700	16.6421	(77)
South	9.5500	56.7559	0.4600	0.0000	0.7700	191.9829	(78)
Northwest	2.0700	14.6176	0.4600	0.0000	0.7700	10.7176	(81)
South	9.4900	56.7559	0.4600	0.0000	0.7700	190.7768	(78)

Solar gains	476.4651	685.2163	943.2742	1193.3479	1298.2433	1416.5913	1347.9838	1241.2720	1082.8237	815.2016	567.2938	402.0133	(83)
Total gains	1264.0565	1467.3735	1694.5027	1892.4933	1943.1041	2018.7375	1925.6754	1829.7449	1705.1403	1488.3379	1293.4829	1168.0256	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8064	29.9914	29.9310	30.0505	30.0505	30.1082	30.1647	30.2198	30.2735	30.1082	30.2198	30.1082	
alpha	2.9871	2.9994	2.9954	3.0034	3.0034	3.0072	3.0110	3.0147	3.0182	3.0072	3.0147	3.0072	
util living area													
	0.9603	0.9398	0.8941	0.8099	0.6879	0.5046	0.3788	0.3960	0.6152	0.8284	0.9313	0.9666	(86)
MIT	19.2121	19.4494	19.8751	20.3476	20.7050	20.9165	20.9739	20.9707	20.8428	20.4155	19.7703	19.1749	(87)
Th 2	19.8392	19.8455	19.8434	19.8475	19.8475	19.8494	19.8513	19.8531	19.8549	19.8494	19.8531	19.8494	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9525	0.9283	0.8740	0.7738	0.6274	0.4173	0.2734	0.2868	0.5308	0.7866	0.9158	0.9599	(89)
MIT 2	17.5134	17.8552	18.4543	19.1024	19.5596	19.7911	19.8403	19.8406	19.7295	19.2112	18.3249	17.4672	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.7052	18.0352	18.6147	19.2430	19.6889	19.9181	19.9683	19.9682	19.8552	19.3472	18.4881	17.6600	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5552	17.8852	18.4647	19.0930	19.5389	19.7681	19.8183	19.8182	19.7052	19.1972	18.3381	17.5100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9303	0.9019	0.8436	0.7459	0.6093	0.4107	0.2702	0.2833	0.5186	0.7578	0.8879	0.9397	(94)
Useful gains	1175.9091	1323.3931	1429.4855	1411.6648	1183.9361	829.0745	520.3408	518.3344	884.3114	1127.8351	1148.4594	1097.6175	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2488.5856	2459.5621	2245.0966	1871.0949	1372.9222	869.8321	528.1826	527.2099	969.0623	1517.9035	2024.5194	2435.3701	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	976.6313	763.5055	606.8146	330.7897	140.6057	0.0000	0.0000	0.0000	0.0000	290.2109	630.7631	995.2880	(98)
Space heating												4734.6089	(98)
Space heating per m2											(98) / (4) =	31.3509	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5225.8376	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	976.6313	763.5055	606.8146	330.7897	140.6057	0.0000	0.0000	0.0000	0.0000	290.2109	630.7631	995.2880	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1077.9595	842.7213	669.7733	365.1100	155.1939	0.0000	0.0000	0.0000	0.0000	320.3211	696.2065	1098.5519	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	177.1568	138.4547	112.7288	58.9858	30.2923	3.1482	0.0000	28.4337	60.5873	113.7479	151.6449	177.5310	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7746	88.7751	88.7382	88.8004	88.4993	79.9000	79.9000	79.9000	79.9000	87.3077	88.3079	88.7999	(217)
Fuel for water heating, kWh/month	199.5579	155.9612	127.0352	66.4251	34.2289	3.9402	0.0000	35.5866	75.8289	130.2839	171.7228	199.9225	(219)
Water heating fuel used												1200.4933	(219)
Annual totals kWh/year													
Space heating fuel - main system												5225.8376	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												5627.2637	(238)

10a. Fuel costs - using BEDF prices (522)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5225.8376	10.2300	534.6032	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1200.4933	10.2300	122.8105	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	506.3836	36.7200	185.9441	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			466.9962	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	5225.8376	0.2160	1128.7809	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1200.4933	0.2160	259.3066	(264)
Space and water heating			1388.0875	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			973.3716	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5225.8376	1.2200	6375.5219	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1200.4933	1.2200	1464.6018	(264)
Space and water heating			7840.1237	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	506.3836	3.0700	1554.5978	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			5386.9875	(272)
Primary energy kWh/m2/year			35.6707	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	139.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	515.16	(P1)
Transmission heat loss coefficient	123.45	(37)
Summer heat loss coefficient	638.60	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
North East	0.000	1.000	None
South East	0.000	1.000	None
South	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	10.5200	87.1704	0.4600	0.0000	0.9000	379.6517
North East	3.1100	106.0502	0.4600	0.0000	0.9000	136.5439
South East	1.0400	127.3119	0.4600	0.0000	0.9000	54.8154
South	9.5500	118.5567	0.4600	0.0000	0.9000	468.7375
North West	2.0700	106.0502	0.4600	0.0000	0.9000	90.8829
South	9.4900	118.5567	0.4600	0.0000	0.9000	465.7926
total:						1596.4240

	Jun	Jul	Aug	
Solar gains	1705	1596	1465	(P4)
Internal gains	623	599	608	
Total summer gains	2328	2195	2073	(P5)
Summer gain/loss ratio	3.65	3.44	3.25	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 139.7)	1.02	1.02	1.02	
Threshold temperature	20.07	21.76	21.57	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-333	**Issued on Date**	19/06/2023
Assessment Reference	As Built	**Prop Type Ref**	Dawlish-Opp-DET
Property	23, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.42	**TER**	18.81
Environmental	91 B	**% DER<TER**	39.29		
CO_2 Emissions (t/year)	0.74	**DFEE**	52.61	**TFEE**	60.18
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.58		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 97 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.42 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.92 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 2.34 m², No overhang
Windows facing South East: 3.33 m², No overhang
Windows facing South West: 9.99 m², No overhang
Windows facing North West: 5.62 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5675	0.5564	0.5452	0.4896	0.4785	0.4228	0.4228	0.4117	0.4451	0.4785	0.5007	0.5230	(22b)
Effective ac	0.6610	0.6548	0.6486	0.6199	0.6145	0.5894	0.5894	0.5848	0.5991	0.6145	0.6254	0.6368	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	84.7268 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7834	54.2652	53.7573	51.3715	50.9251	48.8472	48.8472	48.4623	49.6475	50.9251	51.8281	52.7722	(38)
Heat transfer coeff	139.5102	138.9920	138.4841	136.0983	135.6519	133.5740	133.5740	133.1892	134.3744	135.6519	136.5549	137.4990	(39)
Average = Sum(39)m / 12 =												136.0962	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4276	1.4224	1.3979	1.3933	1.3720	1.3720	1.3680	1.3802	1.3933	1.4026	1.4123	(40)
HLP (average)												1.3979	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use													
	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	417.8424	415.6611	400.6028	376.1820	351.1829	327.2146	311.7142	318.0311	330.6319	355.2780	383.6216	405.0753	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	205.4027	360.4433	521.2408	692.8863	819.0297	831.9945	794.2714	697.2751	580.2281	405.9341	247.9494	174.5368	(83)
Total gains	623.2451	776.1044	921.8435	1069.0683	1170.2126	1159.2091	1105.9855	1015.3062	910.8600	761.2121	631.5710	579.6121	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7671	34.8967	35.0247	35.6387	35.7560	36.3122	36.3122	36.4171	36.0959	35.7560	35.5195	35.2757	
alpha	3.3178	3.3264	3.3350	3.3759	3.3837	3.4208	3.4208	3.4278	3.4064	3.3837	3.3680	3.3517	
util living area													
	0.9907	0.9805	0.9582	0.9039	0.8000	0.6451	0.5009	0.5560	0.7799	0.9388	0.9835	0.9927	(86)
MIT	19.0054	19.2778	19.6869	20.2012	20.6176	20.8736	20.9602	20.9431	20.7445	20.1820	19.5025	18.9703	(87)
Th 2	19.7382	19.7422	19.7462	19.7650	19.7685	19.7849	19.7849	19.7879	19.7786	19.7685	19.7614	19.7539	(88)
util rest of house													
	0.9883	0.9755	0.9472	0.8778	0.7454	0.5514	0.3755	0.4287	0.7004	0.9166	0.9784	0.9908	(89)
MIT 2	17.1146	17.5117	18.1025	18.8360	19.3860	19.6927	19.7674	19.7603	19.5627	18.8288	17.8531	17.0728	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.4979	17.8698	18.4237	19.1128	19.6357	19.9321	20.0092	20.0001	19.8023	19.1032	18.1875	17.4575	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3479	17.7198	18.2737	18.9628	19.4857	19.7821	19.8592	19.8501	19.6523	18.9532	18.0375	17.3075	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9634	0.9291	0.8563	0.7308	0.5512	0.3836	0.4357	0.6907	0.8965	0.9674	0.9847	(94)
Useful gains	611.4284	747.7294	856.5102	915.4555	855.2105	638.9528	424.2951	442.3896	629.1583	682.4149	611.0129	570.7728	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1820.3198	1781.8491	1630.4724	1369.5292	1056.1511	692.1939	435.3499	459.5135	746.0876	1133.1250	1493.5699	1802.2719	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	899.4152	694.9285	575.8278	326.9331	149.4998	0.0000	0.0000	0.0000	0.0000	335.3283	635.4410	916.2354	(98)
Space heating												4533.6091	(98)
Space heating per m2											(98) / (4) =	46.5654	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5009.5128	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	899.4152	694.9285	575.8278	326.9331	149.4998	0.0000	0.0000	0.0000	0.0000	335.3283	635.4410	916.2354	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	993.8290	767.8768	636.2738	361.2520	165.1931	0.0000	0.0000	0.0000	0.0000	370.5285	702.1447	1012.4148	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9627	89.9037	89.7867	89.5151	88.9497	87.3000	87.3000	87.3000	87.3000	89.5070	89.8469	89.9838	(217)
Fuel for water heating, kWh/month													
	194.6009	170.7487	177.4682	156.6533	152.3597	135.5997	127.2799	143.7432	144.7757	162.6093	174.9330	188.8987	(219)
Water heating fuel used												1929.6702	(219)
Annual totals kWh/year													
Space heating fuel - main system												5009.5128	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												6192.5896	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5009.5128	0.2160	1082.0548	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.6702	0.2160	416.8088	(264)
Space and water heating			1498.8635	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1111.3815	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.4200	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		28.6484	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.6484	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3695	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 50.9589 46.0274 50.9589 47.6766 47.2549 43.7846 45.2441 47.2549 47.6766 50.9589 49.3151 50.9589 (61)
Total heat required for water heating calculated for each month
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (64)
Total per year (kWh/year) = Sum(64)m = 2130.2265 (64)
Heat gains from water heating, kWh/month
66.2474 58.3050 61.0313 54.0209 52.2113 45.8062 43.6140 48.8819 49.4300 56.4550 60.0474 64.5591 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2100	11.2829	0.6300	0.7000	0.7700	7.6206	(75)
Southeast	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(77)
Southwest	9.4300	36.7938	0.6300	0.7000	0.7700	106.0373	(79)
Northwest	5.3100	11.2829	0.6300	0.7000	0.7700	18.3100	(81)

Solar gains	167.2761	293.5462	424.5206	564.3485	667.1185	677.6902	646.9586	567.9337	472.5733	330.5995	201.9268	142.1385	(83)
Total gains	597.5686	721.6527	837.5642	952.4036	1029.4991	1015.4350	969.2132	897.1760	815.0976	698.3376	598.0058	559.6703	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9977	0.9943	0.9848	0.9535	0.8704	0.7127	0.5491	0.6081	0.8454	0.9731	0.9952	0.9983	(86)
MIT	19.5406	19.7310	20.0283	20.4116	20.7362	20.9274	20.9827	20.9729	20.8325	20.4022	19.9001	19.5116	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9969	0.9924	0.9793	0.9355	0.8205	0.6134	0.4154	0.4721	0.7682	0.9593	0.9932	0.9977	(89)
MIT 2	17.8903	18.1697	18.6025	19.1557	19.5857	19.8052	19.8464	19.8439	19.7154	19.1539	18.4267	17.8553	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.2249	18.4863	18.8916	19.4103	19.8190	20.0327	20.0768	20.0728	19.9419	19.4070	18.7254	18.1911	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2249	18.4863	18.8916	19.4103	19.8190	20.0327	20.0768	20.0728	19.9419	19.4070	18.7254	18.1911	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9890	0.9730	0.9270	0.8194	0.6304	0.4426	0.4995	0.7756	0.9522	0.9902	0.9964	(94)
Useful gains	594.7275	713.7150	814.9773	882.8637	843.5749	640.1482	428.9616	448.1817	632.1941	664.9494	592.1430	557.6659	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1799.3207	1750.7194	1592.4356	1333.3971	1027.5192	679.7708	435.0374	458.5853	734.1969	1114.5927	1478.5223	1788.4903	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	896.2174	696.8669	578.4289	324.3840	136.8545	0.0000	0.0000	0.0000	0.0000	334.5346	638.1931	915.7334	(98)
Space heating												4521.2128	(98)
Space heating per m2											(98) / (4) =	46.4381	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4840.6990	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	896.2174	696.8669	578.4289	324.3840	136.8545	0.0000	0.0000	0.0000	0.0000	334.5346	638.1931	915.7334	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	959.5475	746.1102	619.3029	347.3062	146.5252	0.0000	0.0000	0.0000	0.0000	358.1741	683.2902	980.4426	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2769	88.0589	87.6090	86.5932	84.5292	80.3000	80.3000	80.3000	80.3000	86.5580	87.8365	88.3527	(217)
Fuel for water heating, kWh/month													
	240.0224	212.1010	223.9456	201.2840	199.6370	185.0896	177.3299	197.6813	199.8645	210.7643	219.5328	234.0694	(219)
Water heating fuel used												2501.3218	(219)
Annual totals kWh/year													
Space heating fuel - main system												4840.6990	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												7815.3818	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4840.6990	0.2160	1045.5910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2501.3218	0.2160	540.2855	(264)
Space and water heating			1585.8765	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1831.5509	(272)
Emissions per m2 for space and water heating			16.2888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2888 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			18.8100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.3655	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3655	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4660	0.4568	0.4477	0.4020	0.3929	0.3472	0.3472	0.3380	0.3655	0.3929	0.4111	0.4294	(22b)
Effective ac	0.6086	0.6043	0.6002	0.5808	0.5772	0.5603	0.5603	0.5571	0.5668	0.5772	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.4352	50.0858	49.7434	48.1350	47.8340	46.4331	46.4331	46.1737	46.9727	47.8340	48.4428	49.0793	(38)
Heat transfer coeff	135.1620	134.8127	134.4702	132.8618	132.5609	131.1600	131.1600	130.9005	131.6996	132.5609	133.1696	133.8061	(39)
Average = Sum(39)m / 12 =												132.8603	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3883	1.3847	1.3812	1.3646	1.3616	1.3472	1.3472	1.3445	1.3527	1.3616	1.3678	1.3743	(40)
HLP (average)												1.3646	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)

Distribution loss (46)m = 0.15 x (45)m

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)

Heat gains from water heating, kWh/month

	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482 (71)

Water heating gains (Table 5)

	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130 (72)
Total internal gains												
	384.1344	382.7796	369.4377	347.3539	323.8733	302.0408	288.3524	292.3441	304.1161	326.3439	351.9604	372.1904 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	205.4027	360.4433	521.2408	692.8863	819.0297	831.9945	794.2714	697.2751	580.2281	405.9341	247.9494	174.5368 (83)
Total gains	589.5371	743.2229	890.6785	1040.2402	1142.9030	1134.0353	1082.6238	989.6192	884.3441	732.2780	599.9097	546.7272 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8856	35.9786	36.0702	36.5069	36.5897	36.9805	36.9805	37.0538	36.8290	36.5897	36.4225	36.2492	
alpha	3.3924	3.3986	3.4047	3.4338	3.4393	3.4654	3.4654	3.4703	3.4553	3.4393	3.4282	3.4166	
util living area													
	0.9922	0.9826	0.9611	0.9074	0.8031	0.6485	0.5031	0.5608	0.7860	0.9434	0.9857	0.9939	(86)
MIT	19.0328	19.3044	19.7112	20.2151	20.6273	20.8765	20.9615	20.9440	20.7467	20.1860	19.5113	18.9886	(87)
Th 2	19.7723	19.7751	19.7778	19.7905	19.7929	19.8041	19.8041	19.8061	19.7998	19.7929	19.7881	19.7831	(88)
util rest of house													
	0.9902	0.9782	0.9507	0.8822	0.7496	0.5559	0.3791	0.4345	0.7083	0.9227	0.9813	0.9924	(89)
MIT 2	17.9989	18.2700	18.6718	19.1647	19.5372	19.7421	19.7924	19.7873	19.6524	19.1504	18.4870	17.9628	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.2085	18.4798	18.8826	19.3777	19.7583	19.9721	20.0294	20.0218	19.8743	19.3604	18.6947	18.1708	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2085	18.4798	18.8826	19.3777	19.7583	19.9721	20.0294	20.0218	19.8743	19.3604	18.6947	18.1708	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9865	0.9717	0.9410	0.8718	0.7479	0.5700	0.4037	0.4589	0.7138	0.9131	0.9757	0.9893	(94)
Useful gains	581.5703	722.2003	838.1168	906.9291	854.7486	646.3652	437.0232	454.1444	631.2740	668.6755	585.3355	540.9034	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1879.9023	1830.7237	1665.0855	1392.0812	1068.2093	704.6050	449.8064	474.0994	760.4664	1161.2832	1544.0581	1869.3729	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	965.9590	744.9277	615.2647	349.3095	158.8148	0.0000	0.0000	0.0000	0.0000	366.5002	690.2803	988.3813	(98)
Space heating												4879.4375	(98)
Space heating per m2											(98) / (4) =	50.1175	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1232.9037	970.5837	994.8441	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8295	0.8870	0.8578	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1022.7461	860.8686	853.4230	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1429.0298	1366.7103	1259.8117	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	292.5243	376.3463	302.3532	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												971.2237	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	73.1311	94.0866	75.5883	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												242.8059	(107)
Space cooling per m2												2.4939	(108)
Energy for space heating												50.1175	(99)
Energy for space cooling												2.4939	(108)
Total												52.6114	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

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Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2100	11.2829	0.6300	0.7000	0.7700	7.6206	(75)
Southeast	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(77)
Southwest	9.4300	36.7938	0.6300	0.7000	0.7700	106.0373	(79)
Northwest	5.3100	11.2829	0.6300	0.7000	0.7700	18.3100	(81)

Solar gains	167.2761	293.5462	424.5206	564.3485	667.1185	677.6902	646.9586	567.9337	472.5733	330.5995	201.9268	142.1385	(83)
Total gains	551.4896	676.3961	794.0155	911.7456	991.0242	979.7583	935.3405	860.3162	776.7408	657.0088	553.9634	514.4103	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9984	0.9956	0.9876	0.9599	0.8829	0.7302	0.5663	0.6292	0.8630	0.9785	0.9965	0.9988	(86)
MIT	19.4980	19.6898	19.9902	20.3807	20.7164	20.9196	20.9804	20.9689	20.8149	20.3678	19.8597	19.4695	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9978	0.9941	0.9830	0.9439	0.8358	0.6314	0.4297	0.4908	0.7900	0.9671	0.9950	0.9984	(89)
MIT 2	18.4598	18.6531	18.9533	19.3438	19.6512	19.8161	19.8477	19.8460	19.7457	19.3394	18.8337	18.4400	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6703	18.8633	19.1635	19.5540	19.8672	20.0399	20.0774	20.0737	19.9625	19.5479	19.0417	18.6487	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6703	18.8633	19.1635	19.5540	19.8672	20.0399	20.0774	20.0737	19.9625	19.5479	19.0417	18.6487	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9923	0.9794	0.9389	0.8370	0.6491	0.4577	0.5191	0.7987	0.9632	0.9935	0.9978	(94)
Useful gains	549.8200	671.1930	777.6923	856.0732	829.4970	635.9942	428.1406	446.5503	620.3495	632.8170	550.3517	513.2694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1856.8804	1799.3029	1627.3798	1351.6244	1033.6200	680.6708	435.1091	458.6983	736.7832	1132.4256	1518.7447	1846.9875	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	972.4530	758.0898	632.1676	356.7968	151.8676	0.0000	0.0000	0.0000	0.0000	371.7088	697.2430	992.2862	(98)
Space heating												4932.6128	(98)
Space heating per m2											(98) / (4) =	50.6636	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8452	0.9084	0.8792	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	994.0819	841.1079	834.3308	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1248.7424	1194.6003	1108.7293	0.0000	0.0000	0.0000	0.0000	(103)

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Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	183.3555	262.9983	204.1525	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												650.5064 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	45.8389	65.7496	51.0381	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												162.6266 (107)
Space cooling per m2												1.6704 (108)
Energy for space heating												50.6636 (99)
Energy for space cooling												1.6704 (108)
Total												52.3340 (109)
Target Fabric Energy Efficiency (TFEE)												60.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4673	0.4340	0.4451	0.4228	0.4228	0.4117	0.4006	0.3895	0.3783	0.4117	0.3895	0.4117	(22b)
Effective ac	0.6092	0.5942	0.5991	0.5894	0.5894	0.5848	0.5802	0.5758	0.5716	0.5848	0.5758	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.4890	49.2422	49.6475	48.8472	48.8472	48.4623	48.0878	47.7235	47.3695	48.4623	47.7235	48.4623	(38)
Heat transfer coeff	135.2158	133.9690	134.3744	133.5740	133.5740	133.1892	132.8146	132.4503	132.0963	133.1892	132.4503	133.1892	(39)
Average = Sum(39)m / 12 =												133.3405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3888	1.3760	1.3802	1.3720	1.3720	1.3680	1.3642	1.3604	1.3568	1.3680	1.3604	1.3680	(40)
HLP (average)												1.3696	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
RHI water heating demand                                                                                                                    1718 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

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[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                           m2          Table 6a     Specific data  Specific data      factor              W
                                                          W/m2       or Table 6b    or Table 6c     Table 6d
-----------------------------------------------------------------------------------------------------------------------------
Northeast                                2.3400           14.6176         0.4600         0.0000      0.7700         12.1155 (75)
Southwest                                9.9900           45.1778         0.4600         0.0000      0.7700        159.8598 (79)
Northwest                                5.6200           14.6176         0.4600         0.0000      0.7700         29.0980 (81)
Southeast                                3.3300           45.1778         0.4600         0.0000      0.7700         53.2866 (77)
-----------------------------------------------------------------------------------------------------------------------------

Solar gains    254.3599   380.7797   558.0168   751.5694   848.4193   937.7917   887.6350   795.6410   657.8863   463.4606   306.2198   212.3690 (83)
Total gains    874.5967   996.3533  1149.6942  1306.0003  1364.4740  1419.5342  1349.3379  1266.1428  1149.8268   992.8730   877.3528   815.2996 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           35.8713    36.2051    36.0959    36.3122    36.3122    36.4171    36.5198    36.6203    36.7184    36.4171    36.6203    36.4171
alpha          3.3914     3.4137     3.4064     3.4208     3.4208     3.4278     3.4347     3.4414     3.4479     3.4278     3.4414     3.4278
util living area
                0.9723     0.9574     0.9180     0.8321     0.6982     0.5037     0.3749     0.3967     0.6378     0.8606     0.9503     0.9767 (86)

MIT           19.4396    19.6441    20.0267    20.4694    20.7842    20.9479    20.9857    20.9831    20.8829    20.4988    19.9330    19.4228 (87)
Th 2          19.7719    19.7818    19.7786    19.7849    19.7849    19.7879    19.7909    19.7938    19.7966    19.7879    19.7938    19.7879 (88)
util rest of house
                0.9656     0.9472     0.8984     0.7930     0.6302     0.4082     0.2628     0.2792     0.5433     0.8175     0.9361     0.9709 (89)
MIT 2         17.7624    18.0603    18.5975    19.2001    19.5891    19.7564    19.7862    19.7881    19.7124    19.2591    18.4866    17.7491 (90)
Living area fraction                                                                                        fLA = Living area / (4) =      0.2028 (91)
MIT           18.1024    18.3815    18.8873    19.4574    19.8314    19.9980    20.0294    20.0304    19.9497    19.5105    18.7798    18.0884 (92)
Temperature adjustment                                                                                                                -0.1500
adjusted MIT  17.9524    18.2315    18.7373    19.3074    19.6814    19.8480    19.8794    19.8804    19.7997    19.3605    18.6298    17.9384 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9511     0.9296     0.8772     0.7750     0.6238     0.4132     0.2712     0.2879     0.5435     0.7989     0.9176     0.9580 (94)
Useful gains 831.8493   926.1881  1008.4765  1012.1298   851.1413   586.5536   366.0055   364.5237   624.9815   793.1699   805.0175   781.0248 (95)
Ext temp.      4.9000     5.3000     7.0000     9.5000    12.5000    15.3000    17.1000    17.1000    14.7000    11.4000     7.9000     5.0000 (96)
Heat loss rate W
             1764.8956  1732.4152  1577.1877  1310.0183   959.2529   605.7386   369.1410   368.2650   673.6485  1060.2480  1421.1707  1723.2560 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              694.1865   541.7847   423.1212   214.4797    80.4350     0.0000     0.0000     0.0000     0.0000   198.7061   443.6303   701.0200 (98)
Space heating                                                                                                                        3297.3635 (98)
```

RHI space heating demand 3297 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5675	0.5564	0.5452	0.4896	0.4785	0.4228	0.4228	0.4117	0.4451	0.4785	0.5007	0.5230	(22b)
Effective ac	0.6610	0.6548	0.6486	0.6199	0.6145	0.5894	0.5894	0.5848	0.5991	0.6145	0.6254	0.6368	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7834	54.2652	53.7573	51.3715	50.9251	48.8472	48.8472	48.4623	49.6475	50.9251	51.8281	52.7722	(38)
Heat transfer coeff	139.5102	138.9920	138.4841	136.0983	135.6519	133.5740	133.5740	133.1892	134.3744	135.6519	136.5549	137.4990	(39)
Average = Sum(39)m / 12 =												136.0962	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4276	1.4224	1.3979	1.3933	1.3720	1.3720	1.3680	1.3802	1.3933	1.4026	1.4123	(40)
HLP (average)												1.3979	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

```
Solar gains    205.4027   360.4433   521.2408   692.8863   819.0297   831.9945   794.2714   697.2751   580.2281   405.9341   247.9494   174.5368 (83)
Total gains    825.6395   976.0169  1112.9182  1247.3172  1335.0844  1313.7370  1255.9743  1167.7769  1072.1685   935.3465   819.0824   777.4674 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           34.7671    34.8967    35.0247    35.6387    35.7560    36.3122    36.3122    36.4171    36.0959    35.7560    35.5195    35.2757
alpha          3.3178     3.3264     3.3350     3.3759     3.3837     3.4208     3.4208     3.4278     3.4064     3.3837     3.3680     3.3517
util living area
                0.9791     0.9633     0.9325     0.8650     0.7496     0.5893     0.4487     0.4956     0.7140     0.8995     0.9656     0.9826 (86)

MIT           19.2278    19.4868    19.8672    20.3334    20.6935    20.9047    20.9715    20.9600    20.8095    20.3309    19.7016    19.1909 (87)
Th 2          19.7382    19.7422    19.7462    19.7650    19.7685    19.7849    19.7849    19.7879    19.7786    19.7685    19.7614    19.7539 (88)
util rest of house
                0.9740     0.9545     0.9161     0.8322     0.6901     0.4975     0.3332     0.3772     0.6287     0.8675     0.9558     0.9783 (89)
MIT 2         17.4356    17.8098    18.3528    19.0073    19.4704    19.7176    19.7728    19.7693    19.6250    19.0244    18.1364    17.3922 (90)
Living area fraction                                                                                             fLA = Living area / (4) =      0.2028 (91)
MIT           17.7990    18.1498    18.6598    19.2762    19.7184    19.9582    20.0159    20.0107    19.8652    19.2893    18.4538    17.7569 (92)
Temperature adjustment                                                                                                                     -0.1500
adjusted MIT  17.6490    17.9998    18.5098    19.1262    19.5684    19.8082    19.8659    19.8607    19.7152    19.1393    18.3038    17.6069 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9614     0.9375     0.8949     0.8118     0.6792     0.4994     0.3412     0.3847     0.6237     0.8465     0.9394     0.9672 (94)
Useful gains  793.7628   915.0040   995.9950  1012.5473   906.8001   656.1116   428.5160   449.2081   668.7519   791.7851   769.4376   751.9783 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1862.3175  1820.7725  1663.1707  1391.7690  1067.3665   695.6858   436.2328   460.9256   754.5383  1158.3675  1529.9287  1843.4292 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              795.0047   608.6765   496.3787   273.0396   119.4614     0.0000     0.0000     0.0000     0.0000   272.7373   547.5536   812.0395 (98)
Space heating                                                                                                                             3924.8912 (98)
Space heating per m2                                                                                                   (98) / (4) =      40.3132 (99)
```

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4336.8963	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	795.0047	608.6765	496.3787	273.0396	119.4614	0.0000	0.0000	0.0000	0.0000	272.7373	547.5536	812.0395	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	878.4582	672.5707	548.4847	301.7012	132.0015	0.0000	0.0000	0.0000	0.0000	301.3672	605.0316	897.2812	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9053	89.8368	89.7010	89.3882	88.7706	87.3000	87.3000	87.3000	87.3000	89.3602	89.7662	89.9294	(217)
Fuel for water heating, kWh/month													
	194.7252	170.8760	177.6377	156.8756	152.6672	135.5997	127.2799	143.7432	144.7757	162.8763	175.0904	189.0130	(219)
Water heating fuel used												1931.1599	(219)
Annual totals kWh/year													
Space heating fuel - main system												4336.8963	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5521.4627	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4336.8963	3.4800	150.9240	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1931.1599	3.4800	67.2044	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			239.6527	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7070	(257)
SAP value		90.1368	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4336.8963	0.2160	936.7696	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1931.1599	0.2160	417.1305	(264)
Space and water heating			1353.9001	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			966.4181	(272)
CO2 emissions per m2			9.9300	(273)
EI value			90.9033	
EI rating			91	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4673	0.4340	0.4451	0.4228	0.4228	0.4117	0.4006	0.3895	0.3783	0.4117	0.3895	0.4117	(22b)
Effective ac	0.6092	0.5942	0.5991	0.5894	0.5894	0.5848	0.5802	0.5758	0.5716	0.5848	0.5758	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.4890	49.2422	49.6475	48.8472	48.8472	48.4623	48.0878	47.7235	47.3695	48.4623	47.7235	48.4623	(38)
Heat transfer coeff	135.2158	133.9690	134.3744	133.5740	133.5740	133.1892	132.8146	132.4503	132.0963	133.1892	132.4503	133.1892	(39)
Average = Sum(39)m / 12 =												133.3405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3888	1.3760	1.3802	1.3720	1.3720	1.3680	1.3642	1.3604	1.3568	1.3680	1.3604	1.3680	(40)
HLP (average)												1.3696	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	14.6176	0.4600	0.0000	0.7700	12.1155	(75)
Southwest	9.9900	45.1778	0.4600	0.0000	0.7700	159.8598	(79)
Northwest	5.6200	14.6176	0.4600	0.0000	0.7700	29.0980	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

```
Solar gains    254.3599   380.7797   558.0168   751.5694   848.4193   937.7917   887.6350   795.6410   657.8863   463.4606   306.2198   212.3690 (83)
Total gains    874.5967   996.3533  1149.6942  1306.0003  1364.4740  1419.5342  1349.3379  1266.1428  1149.8268   992.8730   877.3528   815.2996 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            35.8713    36.2051    36.0959    36.3122    36.3122    36.4171    36.5198    36.6203    36.7184    36.4171    36.6203    36.4171
alpha           3.3914     3.4137     3.4064     3.4208     3.4208     3.4278     3.4347     3.4414     3.4479     3.4278     3.4414     3.4278
util living area
                0.9723     0.9574     0.9180     0.8321     0.6982     0.5037     0.3749     0.3967     0.6378     0.8606     0.9503     0.9767 (86)

MIT            19.4396    19.6441    20.0267    20.4694    20.7842    20.9479    20.9857    20.9831    20.8829    20.4988    19.9330    19.4228 (87)
Th 2           19.7719    19.7818    19.7786    19.7849    19.7849    19.7879    19.7909    19.7938    19.7966    19.7879    19.7938    19.7879 (88)
util rest of house
                0.9656     0.9472     0.8984     0.7930     0.6302     0.4082     0.2628     0.2792     0.5433     0.8175     0.9361     0.9709 (89)
MIT 2          17.7624    18.0603    18.5975    19.2001    19.5891    19.7564    19.7862    19.7881    19.7124    19.2591    18.4866    17.7491 (90)
Living area fraction                                                                                        fLA = Living area / (4) =      0.2028 (91)
MIT            18.1024    18.3815    18.8873    19.4574    19.8314    19.9980    20.0294    20.0304    19.9497    19.5105    18.7798    18.0884 (92)
Temperature adjustment                                                                                                                -0.1500
adjusted MIT   17.9524    18.2315    18.7373    19.3074    19.6814    19.8480    19.8794    19.8804    19.7997    19.3605    18.6298    17.9384 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9511     0.9296     0.8772     0.7750     0.6238     0.4132     0.2712     0.2879     0.5435     0.7989     0.9176     0.9580 (94)
Useful gains  831.8493   926.1881  1008.4765  1012.1298   851.1413   586.5536   366.0055   364.5237   624.9815   793.1699   805.0175   781.0248 (95)
Ext temp.       4.9000     5.3000     7.0000     9.5000    12.5000    15.3000    17.1000    17.1000    14.7000    11.4000     7.9000     5.0000 (96)
Heat loss rate W
             1764.8956  1732.4152  1577.1877  1310.0183   959.2529   605.7386   369.1410   368.2650   673.6485  1060.2480  1421.1707  1723.2560 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              694.1865   541.7847   423.1212   214.4797    80.4350     0.0000     0.0000     0.0000     0.0000   198.7061   443.6303   701.0200 (98)
Space heating                                                                                                                        3297.3635 (98)
Space heating per m2                                                                                                  (98) / (4) =     33.8677 (99)
```

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3643.4956	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	694.1865	541.7847	423.1212	214.4797	80.4350	0.0000	0.0000	0.0000	0.0000	198.7061	443.6303	701.0200	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	767.0569	598.6571	467.5372	236.9942	88.8785	0.0000	0.0000	0.0000	0.0000	219.5648	490.1992	774.6078	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8368	89.7735	89.6015	89.2073	88.4651	87.3000	87.3000	87.3000	87.3000	89.1189	89.6404	89.8572	(217)
Fuel for water heating, kWh/month													
	194.8736	170.9965	177.8350	157.1938	153.1944	135.5997	127.2799	143.7432	144.7757	163.3174	175.3360	189.1649	(219)
Water heating fuel used												1933.3100	(219)
Annual totals kWh/year													
Space heating fuel - main system												3643.4956	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4679.7921	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3643.4956	9.7400	354.8765	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1933.3100	9.7400	188.3044	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	396.9635	36.8500	146.2811	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			316.6314	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3643.4956	0.2160	786.9950	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.3100	0.2160	417.5950	(264)
Space and water heating			1204.5900	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			739.0400	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3643.4956	1.2200	4445.0646	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.3100	1.2200	2358.6383	(264)
Space and water heating			6803.7029	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			4049.8712 (272)
Primary energy kWh/m2/year			41.5969 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 80	-192 kg (26.0%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£80	1.98 kg/m²	B 91	A 93
	Total Savings	£80	1.98 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£174	£192	-£18
Mains gas	£647	£549	£98
Space heating	£487	£487	£0
Water heating	£188	£108	£80
Lighting	£146	£146	£0
Generated (PV)	-£504	-£504	£0
Total cost of fuels	£317	£237	£80
Total cost of uses	£317	£237	£80
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	31 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5675	0.5564	0.5452	0.4896	0.4785	0.4228	0.4228	0.4117	0.4451	0.4785	0.5007	0.5230	(22b)
Effective ac	0.6610	0.6548	0.6486	0.6199	0.6145	0.5894	0.5894	0.5848	0.5991	0.6145	0.6254	0.6368	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7834	54.2652	53.7573	51.3715	50.9251	48.8472	48.8472	48.4623	49.6475	50.9251	51.8281	52.7722	(38)
Heat transfer coeff	139.5102	138.9920	138.4841	136.0983	135.6519	133.5740	133.5740	133.1892	134.3744	135.6519	136.5549	137.4990	(39)
Average = Sum(39)m / 12 =												136.0962	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4276	1.4224	1.3979	1.3933	1.3720	1.3720	1.3680	1.3802	1.3933	1.4026	1.4123	(40)
HLP (average)												1.3979	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.1684 (H8)
Utilisation factor                                                                                                                    0.5751 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -866.7922 (H17)
Solar input    -25.1352   -41.9435   -71.4346   -95.7364  -118.2743  -116.2825  -114.7457  -100.2539   -78.5189   -53.6192   -29.8140   -21.0339 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -866.7922 (63)
Output from w/h
              149.9330   111.5660    87.9082    44.4919    17.2493     2.0961     0.0000    25.2339    47.8702    91.9274   127.3579   148.9444 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    854.5783 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)


-------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
                76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
               620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)


-------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------
[Jan]                                      Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a       Specific data    Specific data        factor                W
                                                          W/m2         or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------
Northeast                                2.3400           11.2829           0.4600           0.0000           0.7700           9.3516 (75)
Southwest                                9.9900           36.7938           0.4600           0.0000           0.7700         130.1934 (79)
Northwest                                5.6200           11.2829           0.4600           0.0000           0.7700          22.4599 (81)
Southeast                                3.3300           36.7938           0.4600           0.0000           0.7700          43.3978 (77)
-------------------------------------------------------------------------------------------------------

Solar gains    205.4027   360.4433   521.2408   692.8863   819.0297   831.9945   794.2714   697.2751   580.2281   405.9341   247.9494   174.5368 (83)
Total gains    825.6395   976.0169  1112.9182  1247.3172  1335.0844  1313.7370  1255.9743  1167.7769  1072.1685   935.3465   819.0824   777.4674 (84)


-------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            34.7671    34.8967    35.0247    35.6387    35.7560    36.3122    36.3122    36.4171    36.0959    35.7560    35.5195    35.2757
alpha           3.3178     3.3264     3.3350     3.3759     3.3837     3.4208     3.4208     3.4278     3.4064     3.3837     3.3680     3.3517
util living area
                0.9791     0.9633     0.9325     0.8650     0.7496     0.5893     0.4487     0.4956     0.7140     0.8995     0.9656     0.9826 (86)

MIT            19.2278    19.4868    19.8672    20.3334    20.6935    20.9047    20.9715    20.9600    20.8095    20.3309    19.7016    19.1909 (87)
Th 2           19.7382    19.7422    19.7462    19.7650    19.7685    19.7849    19.7849    19.7879    19.7786    19.7685    19.7614    19.7539 (88)
util rest of house
                0.9740     0.9545     0.9161     0.8322     0.6901     0.4975     0.3332     0.3772     0.6287     0.8675     0.9558     0.9783 (89)
MIT 2          17.4356    17.8098    18.3528    19.0073    19.4704    19.7176    19.7728    19.7693    19.6250    19.0244    18.1364    17.3922 (90)
Living area fraction                                                                                 fLA = Living area / (4) =           0.2028 (91)
MIT            17.7990    18.1498    18.6598    19.2762    19.7184    19.9582    20.0159    20.0107    19.8652    19.2893    18.4538    17.7569 (92)
Temperature adjustment                                                                                                               -0.1500
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

adjusted MIT	17.6490	17.9998	18.5098	19.1262	19.5684	19.8082	19.8659	19.8607	19.7152	19.1393	18.3038	17.6069	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9614	0.9375	0.8949	0.8118	0.6792	0.4994	0.3412	0.3847	0.6237	0.8465	0.9394	0.9672	(94)
Useful gains	793.7628	915.0040	995.9950	1012.5473	906.8001	656.1116	428.5160	449.2081	668.7519	791.7851	769.4376	751.9783	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1862.3175	1820.7725	1663.1707	1391.7690	1067.3665	695.6858	436.2328	460.9256	754.5383	1158.3675	1529.9287	1843.4292	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	795.0047	608.6765	496.3787	273.0396	119.4614	0.0000	0.0000	0.0000	0.0000	272.7373	547.5536	812.0395	(98)
Space heating												3924.8912	(98)
Space heating per m2											(98) / (4) =	40.3132	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4336.8963	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	795.0047	608.6765	496.3787	273.0396	119.4614	0.0000	0.0000	0.0000	0.0000	272.7373	547.5536	812.0395	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	878.4582	672.5707	548.4847	301.7012	132.0015	0.0000	0.0000	0.0000	0.0000	301.3672	605.0316	897.2812	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9767	89.9890	90.0036	90.0376	90.0834	87.3000	87.3000	87.3000	87.3000	89.6714	89.8783	89.9888	(217)
Fuel for water heating, kWh/month	166.6354	123.9773	97.6719	49.4148	19.1481	2.4010	0.0000	28.9048	54.8342	102.5159	141.7004	165.5144	(219)
Water heating fuel used												952.7181	(219)
Annual totals kWh/year													
Space heating fuel - main system												4336.8963	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4593.0209	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4336.8963	3.4800	150.9240	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.7181	3.4800	33.1546	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			212.1979	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6260	(257)
SAP value		91.2667	
SAP rating (Section 12)		91	(258)
SAP band		B	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4336.8963	0.2160	936.7696	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.7181	0.2160	205.7871	(264)
Space and water heating			1142.5567	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			781.0247	(272)
CO2 emissions per m2			8.0200	(273)
EI value			92.6484	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4451	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4451	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4673	0.4340	0.4451	0.4228	0.4228	0.4117	0.4006	0.3895	0.3783	0.4117	0.3895	0.4117	(22b)
Effective ac	0.6092	0.5942	0.5991	0.5894	0.5894	0.5848	0.5802	0.5758	0.5716	0.5848	0.5758	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.4890	49.2422	49.6475	48.8472	48.8472	48.4623	48.0878	47.7235	47.3695	48.4623	47.7235	48.4623	(38)
Heat transfer coeff	135.2158	133.9690	134.3744	133.5740	133.5740	133.1892	132.8146	132.4503	132.0963	133.1892	132.4503	133.1892	(39)
Average = Sum(39)m / 12 =												133.3405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3888	1.3760	1.3802	1.3720	1.3720	1.3680	1.3642	1.3604	1.3568	1.3680	1.3604	1.3680	(40)
HLP (average)												1.3696	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
             108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
             175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1208.1510 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             2029.6937 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.3077 (H8)
Utilisation factor                                                                                                                    0.5345 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -901.6911 (H17)
Solar input    -29.4153   -41.8267   -71.8901   -96.9964  -113.9281  -121.6932  -119.1340  -106.6286   -83.4828   -57.7171   -34.7906   -24.1880 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =  -901.6911 (63)
Output from w/h
             145.6529   111.6827    87.4527    43.2319    21.5954     0.0000     0.0000    18.8592    42.9063    87.8295   122.3814   145.7903 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   827.3824 (64)
Heat gains from water heating, kWh/month
              57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

---

6. Solar gains

```
[Jan]                                    Area        Solar flux              g                FF            Access            Gains
                                         m2          Table 6a      Specific data      Specific data       factor                W
                                                       W/m2        or Table 6b        or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                              2.3400          14.6176          0.4600             0.0000         0.7700           12.1155 (75)
Southwest                              9.9900          45.1778          0.4600             0.0000         0.7700          159.8598 (79)
Northwest                              5.6200          14.6176          0.4600             0.0000         0.7700           29.0980 (81)
Southeast                              3.3300          45.1778          0.4600             0.0000         0.7700           53.2866 (77)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    254.3599   380.7797   558.0168   751.5694   848.4193   937.7917   887.6350   795.6410   657.8863   463.4606   306.2198   212.3690 (83)
Total gains    874.5967   996.3533  1149.6942  1306.0003  1364.4740  1419.5342  1349.3379  1266.1428  1149.8268   992.8730   877.3528   815.2996 (84)
```

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            35.8713    36.2051    36.0959    36.3122    36.3122    36.4171    36.5198    36.6203    36.7184    36.4171    36.6203    36.4171
alpha           3.3914     3.4137     3.4064     3.4208     3.4208     3.4278     3.4347     3.4414     3.4479     3.4278     3.4414     3.4278
util living area
                0.9723     0.9574     0.9180     0.8321     0.6982     0.5037     0.3749     0.3967     0.6378     0.8606     0.9503     0.9767 (86)

MIT            19.4396    19.6441    20.0267    20.4694    20.7842    20.9479    20.9857    20.9831    20.8829    20.4988    19.9330    19.4228 (87)
Th 2           19.7719    19.7818    19.7786    19.7849    19.7849    19.7879    19.7909    19.7938    19.7966    19.7879    19.7938    19.7879 (88)
util rest of house
                0.9656     0.9472     0.8984     0.7930     0.6302     0.4082     0.2628     0.2792     0.5433     0.8175     0.9361     0.9709 (89)
MIT 2          17.7624    18.0603    18.5975    19.2001    19.5891    19.7564    19.7862    19.7881    19.7124    19.2591    18.4866    17.7491 (90)
Living area fraction                                                                                    fLA = Living area / (4) =     0.2028 (91)
MIT            18.1024    18.3815    18.8873    19.4574    19.8314    19.9980    20.0294    20.0304    19.9497    19.5105    18.7798    18.0884 (92)
Temperature adjustment                                                                                                             -0.1500
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

adjusted MIT	17.9524	18.2315	18.7373	19.3074	19.6814	19.8480	19.8794	19.8804	19.7997	19.3605	18.6298	17.9384	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9296	0.8772	0.7750	0.6238	0.4132	0.2712	0.2879	0.5435	0.7989	0.9176	0.9580	(94)
Useful gains	831.8493	926.1881	1008.4765	1012.1298	851.1413	586.5536	366.0055	364.5237	624.9815	793.1699	805.0175	781.0248	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1764.8956	1732.4152	1577.1877	1310.0183	959.2529	605.7386	369.1410	368.2650	673.6485	1060.2480	1421.1707	1723.2560	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	694.1865	541.7847	423.1212	214.4797	80.4350	0.0000	0.0000	0.0000	0.0000	198.7061	443.6303	701.0200	(98)
Space heating												3297.3635	(98)
Space heating per m2											(98) / (4) =	33.8677	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3643.4956	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	694.1865	541.7847	423.1212	214.4797	80.4350	0.0000	0.0000	0.0000	0.0000	198.7061	443.6303	701.0200	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	767.0569	598.6571	467.5372	236.9942	88.8785	0.0000	0.0000	0.0000	0.0000	219.5648	490.1992	774.6078	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9283	89.9366	89.9353	89.9469	89.8033	87.3000	87.3000	87.3000	87.3000	89.4945	89.7884	89.9325	(217)
Fuel for water heating, kWh/month	161.9655	124.1794	97.2395	48.0638	24.0474	0.0000	0.0000	21.6028	49.1482	98.1396	136.2998	162.1109	(219)
Water heating fuel used												922.7969	(219)
Annual totals kWh/year													
Space heating fuel - main system												3643.4956	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3719.2789	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3643.4956	9.7400	354.8765	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	922.7969	9.7400	89.8804	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	396.9635	36.8500	146.2811	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			236.6324	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3643.4956	0.2160	786.9950	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.7969	0.2160	199.3241	(264)
Space and water heating			986.3192	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			546.7191 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3643.4956	1.2200	4445.0646	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.7969	1.2200	1125.8122	(264)
Space and water heating			5570.8769	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2970.5452	(272)
Primary energy kWh/m2/year			30.5109	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		331.51 (P1)
Transmission heat loss coefficient		84.73 (37)
Summer heat loss coefficient		416.23 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.3400	106.0502	0.4600	0.0000	0.9000	102.7372
South West	9.9900	127.3119	0.4600	0.0000	0.9000	526.5440
North West	5.6200	106.0502	0.4600	0.0000	0.9000	246.7449
South East	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						1051.5408

	Jun	Jul	Aug	
Solar gains	1129	1052	939	(P4)
Internal gains	479	459	468	
Total summer gains	1608	1510	1407	(P5)
Summer gain/loss ratio	3.86	3.63	3.38	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	20.01	21.67	21.42	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-334	**Issued on Date**	18/10/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-Opp-DET
Property	22, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	89 B	**DER**	12.24	**TER**	18.97
Environmental	90 B	**% DER<TER**	35.47		
CO_2 Emissions (t/year)	0.87	**DFEE**	52.61	**TFEE**	60.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.97 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.24 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.6 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.15 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 8.35 m², No overhang
Windows facing West: 6.36 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.1500	
Infiltration rate				0.3994	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5093	0.4993	0.4893	0.4394	0.4294	0.3795	0.3795	0.3695	0.3994	0.4294	0.4494	0.4693	(22b)
Effective ac	0.6297	0.6246	0.6197	0.5965	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6101	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1336	53.7007	53.2764	51.2833	50.9104	49.1745	49.1745	48.8530	49.8431	50.9104	51.6648	52.4534	(38)
Heat transfer coeff	132.0927	131.6598	131.2354	129.2423	128.8694	127.1335	127.1335	126.8121	127.8022	128.8694	129.6238	130.4125	(39)
Average = Sum(39)m / 12 =												129.2405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3107	1.3064	1.3022	1.2824	1.2787	1.2615	1.2615	1.2583	1.2681	1.2787	1.2862	1.2940	(40)
HLP (average)												1.2824	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	528.7711	624.2635	738.1890	864.2010	946.9475	936.3916	891.7295	817.2758	720.4953	599.9568	519.0834	497.6140	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8550	33.9663	34.0762	34.6017	34.7018	35.1756	35.1756	35.2648	34.9916	34.7018	34.4998	34.2912	
alpha	3.2570	3.2644	3.2717	3.3068	3.3135	3.3450	3.3450	3.3510	3.3328	3.3135	3.3000	3.2861	
util living area													
	0.9927	0.9869	0.9719	0.9318	0.8493	0.7131	0.5707	0.6280	0.8401	0.9602	0.9882	0.9941	(86)
MIT	18.8941	19.1143	19.5118	20.0430	20.5022	20.8150	20.9360	20.9110	20.6499	20.0352	19.3757	18.8663	(87)
Th 2	19.8325	19.8358	19.8391	19.8546	19.8575	19.8711	19.8711	19.8736	19.8659	19.8575	19.8517	19.8455	(88)
util rest of house													
	0.9910	0.9838	0.9648	0.9135	0.8066	0.6289	0.4462	0.5054	0.7778	0.9463	0.9849	0.9927	(89)
MIT 2	17.0293	17.3519	17.9299	18.6974	19.3259	19.7203	19.8378	19.8226	19.5386	18.7012	17.7442	16.9965	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3537	17.6585	18.2051	18.9315	19.5305	19.9107	20.0288	20.0119	19.7319	18.9332	18.0280	17.3217	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2037	17.5085	18.0551	18.7815	19.3805	19.7607	19.8788	19.8619	19.5819	18.7832	17.8780	17.1717	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9847	0.9740	0.9490	0.8908	0.7849	0.6196	0.4472	0.5040	0.7583	0.9271	0.9757	0.9873	(94)
Useful gains	520.6550	608.0186	700.5135	769.8498	743.2223	580.1582	398.7385	411.8745	546.3632	556.2101	506.4722	491.2811	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1704.4852	1660.0271	1516.4376	1277.1031	989.7834	656.0998	416.8459	439.0135	700.5994	1054.5645	1397.0850	1691.6718	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	880.7697	706.9497	607.0475	365.2224	183.4415	0.0000	0.0000	0.0000	0.0000	370.7756	641.2412	893.0906	(98)
Space heating												4648.5383	(98)
Space heating per m2											(98) / (4) =	46.1256	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5136.5064	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	880.7697	706.9497	607.0475	365.2224	183.4415	0.0000	0.0000	0.0000	0.0000	370.7756	641.2412	893.0906	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	973.2262	781.1599	670.7708	403.5607	202.6978	0.0000	0.0000	0.0000	0.0000	409.6968	708.5538	986.8405	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9500	89.9085	89.8116	89.5843	89.1066	87.3000	87.3000	87.3000	87.3000	89.5697	89.8479	89.9695	(217)
Fuel for water heating, kWh/month													
	196.0499	171.9834	178.7039	157.6579	153.1772	136.5557	128.1658	144.7599	145.8047	163.6616	176.2003	190.3052	(219)
Water heating fuel used												1943.0255	(219)
Annual totals kWh/year													
Space heating fuel - main system												5136.5064	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =												-1074.8994	(233)
Total delivered energy for all uses												6510.8151	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5136.5064	0.2160	1109.4854	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1943.0255	0.2160	419.6935	(264)
Space and water heating			1529.1789	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			1234.0148	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		12.2400	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		29.2205	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.2205	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
West	6.3600	19.6403	0.6300	0.7000	0.7700	38.1748	(80)

Solar gains	88.2941	172.7220	284.4486	414.8513	508.4159	520.4541	495.4935	425.6216	330.8255	204.9493	110.0924	72.6088	(83)
Total gains	527.1038	609.1779	705.3495	810.2065	877.4082	864.2709	823.5853	760.9069	679.8708	579.7674	513.9609	498.4446	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9989	0.9976	0.9930	0.9746	0.9164	0.7805	0.6164	0.6788	0.9030	0.9875	0.9978	0.9992	(86)
MIT	19.5563	19.7053	19.9791	20.3564	20.6897	20.9083	20.9774	20.9647	20.7923	20.3524	19.8938	19.5406	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9985	0.9967	0.9902	0.9639	0.8793	0.6892	0.4797	0.5434	0.8445	0.9806	0.9968	0.9989	(89)
MIT 2	17.9545	18.1746	18.5762	19.1306	19.5887	19.8557	19.9115	19.9073	19.7351	19.1331	18.4619	17.9409	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2331	18.4409	18.8202	19.3438	19.7803	20.0388	20.0969	20.0912	19.9190	19.3452	18.7110	18.2191	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2331	18.4409	18.8202	19.3438	19.7803	20.0388	20.0969	20.0912	19.9190	19.3452	18.7110	18.2191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9949	0.9864	0.9565	0.8741	0.7005	0.5034	0.5664	0.8448	0.9754	0.9952	0.9981	(94)
Useful gains	525.8160	606.0792	695.7545	774.9516	766.9001	605.4357	414.6235	430.9559	574.3655	565.5077	511.5045	497.5164	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1755.3643	1699.9624	1541.3817	1285.3812	991.4067	657.6727	422.8568	445.1462	707.6234	1072.9912	1433.5504	1742.1565	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	914.7840	735.0895	629.1466	367.5093	167.0329	0.0000	0.0000	0.0000	0.0000	377.5677	663.8731	926.0122	(98)
Space heating												4781.0153	(98)
Space heating per m2											(98) / (4) =	47.4401	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5118.8601	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	914.7840	735.0895	629.1466	367.5093	167.0329	0.0000	0.0000	0.0000	0.0000	377.5677	663.8731	926.0122	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	979.4261	787.0337	673.6045	393.4789	178.8361	0.0000	0.0000	0.0000	0.0000	404.2481	710.7849	991.4478	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3011	88.1431	87.7642	86.8663	85.0056	80.3000	80.3000	80.3000	80.3000	86.8285	87.9001	88.3612	(217)
Fuel for water heating, kWh/month													
	241.4012	213.1640	224.8615	202.2417	200.0917	186.5567	178.7355	199.2482	201.4487	211.3080	220.6679	235.4450	(219)
Water heating fuel used												2515.1700	(219)
Annual totals kWh/year													
Space heating fuel - main system												5118.8601	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8140.2126	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5118.8601	0.2160	1105.6738	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.1700	0.2160	543.2767	(264)
Space and water heating			1648.9505	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1911.6592	(272)
Emissions per m2 for space and water heating			16.3619	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3619 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.9700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			4.1500	
Infiltration rate			0.3610	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3610	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4603	0.4513	0.4423	0.3971	0.3881	0.3430	0.3430	0.3340	0.3610	0.3881	0.4062	0.4242	(22b)
Effective ac	0.6060	0.6018	0.5978	0.5789	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0938	51.7401	51.3934	49.7650	49.4603	48.0420	48.0420	47.7794	48.5883	49.4603	50.0767	50.7210	(38)
Heat transfer coeff	130.0529	129.6992	129.3525	127.7241	127.4194	126.0011	126.0011	125.7384	126.5474	127.4194	128.0357	128.6801	(39)
Average = Sum(39)m / 12 =												127.7226	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2905	1.2870	1.2835	1.2674	1.2643	1.2503	1.2503	1.2477	1.2557	1.2643	1.2704	1.2768	(40)
HLP (average)												1.2673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	494.8563	591.1819	706.8374	835.2039	919.4811	911.0781	868.2425	791.4449	693.8290	570.8537	487.2316	464.5288	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3860	34.4798	34.5722	35.0130	35.0967	35.4917	35.4917	35.5659	35.3385	35.0967	34.9277	34.7528	
alpha	3.2924	3.2987	3.3048	3.3342	3.3398	3.3661	3.3661	3.3711	3.3559	3.3398	3.3285	3.3169	
util living area													
	0.9941	0.9888	0.9749	0.9365	0.8561	0.7219	0.5792	0.6392	0.8499	0.9649	0.9902	0.9952	(86)
MIT	18.8849	19.1053	19.5036	20.0336	20.4959	20.8109	20.9345	20.9077	20.6400	20.0188	19.3587	18.8531	(87)
Th 2	19.8483	19.8511	19.8538	19.8665	19.8689	19.8800	19.8800	19.8821	19.8757	19.8689	19.8641	19.8590	(88)
util rest of house													
	0.9926	0.9861	0.9685	0.9194	0.8148	0.6386	0.4547	0.5169	0.7901	0.9524	0.9874	0.9941	(89)
MIT 2	17.9209	18.1422	18.5387	19.0653	19.4993	19.7739	19.8565	19.8455	19.6437	19.0613	18.4051	17.8969	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0886	18.3097	18.7065	19.2337	19.6726	19.9543	20.0440	20.0303	19.8170	19.2278	18.5709	18.0633	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0886	18.3097	18.7065	19.2337	19.6726	19.9543	20.0440	20.0303	19.8170	19.2278	18.5709	18.0633	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9895	0.9810	0.9600	0.9074	0.8063	0.6448	0.4744	0.5348	0.7863	0.9428	0.9829	0.9914	(94)
Useful gains	489.6684	579.9699	678.5326	757.8702	741.4170	587.4888	411.8515	423.2485	545.5353	538.2004	478.8882	460.5563	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1793.2491	1739.2281	1578.9428	1319.8618	1015.8680	674.6467	433.9431	456.4633	723.4677	1099.3513	1468.6910	1783.9247	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	969.8641	779.0215	669.9052	404.6340	204.1915	0.0000	0.0000	0.0000	0.0000	417.4963	712.6580	984.5861	(98)
Space heating												5142.3566	(98)
Space heating per m2											(98) / (4) =	51.0256	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1184.4103	932.4081	955.6122	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7666	0.8356	0.7996	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	907.9251	779.1008	764.0994	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1171.0257	1118.7261	1031.0348	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	189.4324	252.6812	198.5999	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												640.7135	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	47.3581	63.1703	49.6500	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												160.1784	(107)
Space cooling per m2												1.5894	(108)
Energy for space heating												51.0256	(99)
Energy for space cooling												1.5894	(108)
Total												52.6150	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
West	6.3600	19.6403	0.6300	0.7000	0.7700	38.1748	(80)

Solar gains	88.2941	172.7220	284.4486	414.8513	508.4159	520.4541	495.4935	425.6216	330.8255	204.9493	110.0924	72.6088 (83)
Total gains	480.8191	563.7221	661.6151	769.2500	838.6521	828.3352	789.4679	723.7787	641.2337	538.2705	469.7289	452.9853 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9993	0.9983	0.9946	0.9791	0.9274	0.7999	0.6381	0.7044	0.9189	0.9908	0.9985	0.9995	(86)
MIT	19.5142	19.6641	19.9403	20.3229	20.6656	20.8972	20.9739	20.9585	20.7695	20.3163	19.8535	19.4991	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9990	0.9976	0.9925	0.9701	0.8938	0.7109	0.4990	0.5680	0.8665	0.9855	0.9979	0.9993	(89)
MIT 2	18.5233	18.6758	18.9537	19.3438	19.6692	19.8698	19.9131	19.9100	19.7750	19.3433	18.8780	18.5188	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.6957	18.8477	19.1253	19.5141	19.8425	20.0485	20.0977	20.0924	19.9480	19.5125	19.0477	18.6893	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6957	18.8477	19.1253	19.5141	19.8425	20.0485	20.0977	20.0924	19.9480	19.5125	19.0477	18.6893	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9968	0.9905	0.9659	0.8914	0.7229	0.5234	0.5916	0.8686	0.9828	0.9971	0.9989	(94)
Useful gains	480.1327	561.8965	655.2980	743.0131	747.5588	598.8209	413.2298	428.2053	556.9461	529.0359	468.3772	452.5058	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1813.6375	1751.0353	1579.5521	1306.3348	999.0486	658.8514	422.9471	445.2865	711.1477	1093.5235	1475.1246	1800.5898	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	992.1276	799.1013	687.6451	405.5916	187.1084	0.0000	0.0000	0.0000	0.0000	419.9788	724.8581	1002.9745	(98)
Space heating												5219.3853	(98)
Space heating per m2											(98) / (4) =	51.7899	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8051	0.8809	0.8449	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	915.1290	788.2565	774.4131	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1074.3132	1026.6519	951.9444	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	114.6126	177.3662	132.0833	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												424.0621	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                    fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   28.6532   44.3415   33.0208    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          106.0155 (107)
Space cooling per m2                                                                                                     1.0519 (108)
Energy for space heating                                                                                                51.7899 (99)
Energy for space cooling                                                                                                 1.0519 (108)
Total                                                                                                                   52.8418 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                    60.8 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.1500	
Infiltration rate			0.3994	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4194	0.3894	0.3994	0.3795	0.3795	0.3695	0.3595	0.3495	0.3395	0.3695	0.3495	0.3695	(22b)
Effective ac	0.5879	0.5758	0.5798	0.5720	0.5720	0.5683	0.5646	0.5611	0.5576	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.5461	49.5045	49.8431	49.1745	49.1745	48.8530	48.5401	48.2358	47.9400	48.8530	48.2358	48.8530	(38)
Heat transfer coeff	128.5051	127.4636	127.8022	127.1335	127.1335	126.8121	126.4992	126.1948	125.8991	126.8121	126.1948	126.8121	(39)
Average = Sum(39)m / 12 =												126.9385	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2751	1.2648	1.2681	1.2615	1.2615	1.2583	1.2552	1.2522	1.2492	1.2583	1.2522	1.2583	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	25.1925	0.4600	0.0000	0.7700	44.7945	(76)
West	6.3600	25.1925	0.4600	0.0000	0.7700	56.7515	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	131.2602	218.4164	361.6220	528.3806	613.5217	681.4167	643.9682	568.1778	443.4733	279.4029	163.1284	106.1021	(83)
Total gains	766.1516	848.1716	966.4215	1094.5684	1140.0443	1172.7204	1114.9588	1048.4732	946.2474	821.0160	747.7774	723.4355	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8002	35.0845	34.9916	35.1756	35.1756	35.2648	35.3520	35.4373	35.5205	35.2648	35.4373	35.2648	
alpha	3.3200	3.3390	3.3328	3.3450	3.3450	3.3510	3.3568	3.3625	3.3680	3.3510	3.3625	3.3510	
util living area													
	0.9764	0.9664	0.9366	0.8666	0.7488	0.5632	0.4260	0.4491	0.6989	0.8939	0.9607	0.9795	(86)
MIT	19.3307	19.5030	19.8808	20.3490	20.7122	20.9208	20.9767	20.9729	20.8324	20.3864	19.8120	19.3243	(87)
Th 2	19.8604	19.8685	19.8659	19.8711	19.8711	19.8736	19.8761	19.8785	19.8808	19.8736	19.8785	19.8736	(88)
util rest of house													
	0.9711	0.9589	0.9221	0.8357	0.6895	0.4698	0.3105	0.3288	0.6131	0.8612	0.9503	0.9748	(89)
MIT 2	17.6790	17.9319	18.4694	19.1212	19.5906	19.8196	19.8668	19.8675	19.7466	19.1906	18.3874	17.6786	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9663	18.2052	18.7149	19.3348	19.7857	20.0112	20.0598	20.0597	19.9354	19.3986	18.6352	17.9648	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8163	18.0552	18.5649	19.1848	19.6357	19.8612	19.9098	19.9097	19.7854	19.2486	18.4852	17.8148	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9571	0.9421	0.9001	0.8129	0.6755	0.4687	0.3141	0.3323	0.6049	0.8380	0.9320	0.9620	(94)
Useful gains	733.3100	799.0537	869.9232	889.7807	770.0992	549.6398	350.1891	348.3946	572.3839	688.0499	696.9381	695.9687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1659.8167	1625.8200	1478.0153	1231.2566	907.1891	578.4124	355.4424	354.5758	640.2503	995.2966	1335.7957	1625.0756	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	689.3210	555.5870	452.4205	245.8627	101.9949	0.0000	0.0000	0.0000	0.0000	228.5916	459.9774	691.2556	(98)
Space heating												3425.0106	(98)
RHI space heating demand												3425	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.1500	
Infiltration rate				0.3994	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5093	0.4993	0.4893	0.4394	0.4294	0.3795	0.3795	0.3695	0.3994	0.4294	0.4494	0.4693	(22b)
Effective ac	0.6297	0.6246	0.6197	0.5965	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6101	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1336	53.7007	53.2764	51.2833	50.9104	49.1745	49.1745	48.8530	49.8431	50.9104	51.6648	52.4534	(38)
Heat transfer coeff	132.0927	131.6598	131.2354	129.2423	128.8694	127.1335	127.1335	126.8121	127.8022	128.8694	129.6238	130.4125	(39)
Average = Sum(39)m / 12 =												129.2405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3107	1.3064	1.3022	1.2824	1.2787	1.2615	1.2615	1.2583	1.2681	1.2787	1.2862	1.2940	(40)
HLP (average)												1.2824	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

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Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	737.2227	829.9369	934.4703	1046.9931	1115.7676	1094.5007	1045.2588	973.5833	886.1949	779.1455	712.2441	701.4857	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8550	33.9663	34.0762	34.6017	34.7018	35.1756	35.1756	35.2648	34.9916	34.7018	34.4998	34.2912	
alpha	3.2570	3.2644	3.2717	3.3068	3.3135	3.3450	3.3450	3.3510	3.3328	3.3135	3.3000	3.2861	
util living area													
	0.9811	0.9710	0.9478	0.8934	0.7948	0.6457	0.5023	0.5508	0.7673	0.9232	0.9712	0.9838	(86)
MIT	19.1426	19.3523	19.7230	20.2072	20.6065	20.8644	20.9564	20.9402	20.7445	20.2160	19.6010	19.1121	(87)
Th 2	19.8325	19.8358	19.8391	19.8546	19.8575	19.8711	19.8711	19.8736	19.8659	19.8575	19.8517	19.8455	(88)
util rest of house													
	0.9769	0.9645	0.9358	0.8680	0.7448	0.5601	0.3867	0.4345	0.6939	0.8994	0.9637	0.9801	(89)
MIT 2	17.3892	17.6942	18.2283	18.9178	19.4502	19.7650	19.8494	19.8412	19.6397	18.9473	18.0675	17.3531	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6942	17.9826	18.4883	19.1421	19.6514	19.9563	20.0420	20.0323	19.8319	19.1679	18.3342	17.6591	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5442	17.8326	18.3383	18.9921	19.5014	19.8063	19.8920	19.8823	19.6819	19.0179	18.1842	17.5091	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9644	0.9485	0.9148	0.8441	0.7267	0.5547	0.3889	0.4355	0.6800	0.8762	0.9477	0.9690	(94)
Useful gains	710.9979	787.2046	854.8072	883.7736	810.7900	607.0856	406.5483	423.9767	602.5767	682.6812	674.9727	679.7446	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1749.4649	1702.7062	1553.6039	1304.3242	1005.3575	661.8891	418.5188	441.6040	713.3787	1084.8162	1436.7779	1735.6731	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	772.6195	615.2171	519.9047	302.7964	144.7583	0.0000	0.0000	0.0000	0.0000	299.1884	548.4998	785.6108	(98)
Space heating												3988.5950	(98)
Space heating per m2											(98) / (4) =	39.5772	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4407.2872	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	772.6195	615.2171	519.9047	302.7964	144.7583	0.0000	0.0000	0.0000	0.0000	299.1884	548.4998	785.6108	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	853.7232	679.7979	574.4804	334.5817	159.9539	0.0000	0.0000	0.0000	0.0000	330.5950	606.0771	868.0782	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8877	89.8386	89.7242	89.4570	88.9182	87.3000	87.3000	87.3000	87.3000	89.4221	89.7630	89.9103	(217)
Fuel for water heating, kWh/month													
	196.1857	172.1174	178.8779	157.8822	153.5015	136.5557	128.1658	144.7599	145.8047	163.9318	176.3669	190.4305	(219)
Water heating fuel used												1944.5801	(219)
Annual totals kWh/year													
Space heating fuel - main system												4407.2872	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												5783.1505	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4407.2872	3.4800	153.3736	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.5801	3.4800	67.6714	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			266.0312	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7665	(257)
SAP value		89.3080	
SAP rating (Section 12)		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4407.2872	0.2160	951.9740	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.5801	0.2160	420.0293	(264)
Space and water heating			1372.0033	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			1076.8393	(272)
CO2 emissions per m2			10.6900	(273)
EI value			90.1018	
EI rating			90	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.1500	
Infiltration rate			0.3994	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4194	0.3894	0.3994	0.3795	0.3795	0.3695	0.3595	0.3495	0.3395	0.3695	0.3495	0.3695	(22b)
Effective ac	0.5879	0.5758	0.5798	0.5720	0.5720	0.5683	0.5646	0.5611	0.5576	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.5461	49.5045	49.8431	49.1745	49.1745	48.8530	48.5401	48.2358	47.9400	48.8530	48.2358	48.8530	(38)
Heat transfer coeff	128.5051	127.4636	127.8022	127.1335	127.1335	126.8121	126.4992	126.1948	125.8991	126.8121	126.1948	126.8121	(39)
Average = Sum(39)m / 12 =												126.9385	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2751	1.2648	1.2681	1.2615	1.2615	1.2583	1.2552	1.2522	1.2492	1.2583	1.2522	1.2583	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	25.1925	0.4600	0.0000	0.7700	44.7945	(76)
West	6.3600	25.1925	0.4600	0.0000	0.7700	56.7515	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	131.2602	218.4164	361.6220	528.3806	613.5217	681.4167	643.9682	568.1778	443.4733	279.4029	163.1284	106.1021	(83)
Total gains	766.1516	848.1716	966.4215	1094.5684	1140.0443	1172.7204	1114.9588	1048.4732	946.2474	821.0160	747.7774	723.4355	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8002	35.0845	34.9916	35.1756	35.1756	35.2648	35.3520	35.4373	35.5205	35.2648	35.4373	35.2648	
alpha	3.3200	3.3390	3.3328	3.3450	3.3450	3.3510	3.3568	3.3625	3.3680	3.3510	3.3625	3.3510	
util living area													
	0.9764	0.9664	0.9366	0.8666	0.7488	0.5632	0.4260	0.4491	0.6989	0.8939	0.9607	0.9795	(86)
MIT	19.3307	19.5030	19.8808	20.3490	20.7122	20.9208	20.9767	20.9729	20.8324	20.3864	19.8120	19.3243	(87)
Th 2	19.8604	19.8685	19.8659	19.8711	19.8711	19.8736	19.8761	19.8785	19.8808	19.8736	19.8785	19.8736	(88)
util rest of house													
	0.9711	0.9589	0.9221	0.8357	0.6895	0.4698	0.3105	0.3288	0.6131	0.8612	0.9503	0.9748	(89)
MIT 2	17.6790	17.9319	18.4694	19.1212	19.5906	19.8196	19.8668	19.8675	19.7466	19.1906	18.3874	17.6786	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9663	18.2052	18.7149	19.3348	19.7857	20.0112	20.0598	20.0597	19.9354	19.3986	18.6352	17.9648	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8163	18.0552	18.5649	19.1848	19.6357	19.8612	19.9098	19.9097	19.7854	19.2486	18.4852	17.8148	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9571	0.9421	0.9001	0.8129	0.6755	0.4687	0.3141	0.3323	0.6049	0.8380	0.9320	0.9620	(94)
Useful gains	733.3100	799.0537	869.9232	889.7807	770.0992	549.6398	350.1891	348.3946	572.3839	688.0499	696.9381	695.9687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1659.8167	1625.8200	1478.0153	1231.2566	907.1891	578.4124	355.4424	354.5758	640.2503	995.2966	1335.7957	1625.0756	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	689.3210	555.5870	452.4205	245.8627	101.9949	0.0000	0.0000	0.0000	0.0000	228.5916	459.9774	691.2556	(98)
Space heating												3425.0106	(98)
Space heating per m2											(98) / (4) =	33.9850	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3784.5421	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	689.3210	555.5870	452.4205	245.8627	101.9949	0.0000	0.0000	0.0000	0.0000	228.5916	459.9774	691.2556	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	761.6807	613.9082	499.9121	271.6714	112.7015	0.0000	0.0000	0.0000	0.0000	252.5874	508.2624	763.8183	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8292	89.7835	89.6396	89.3056	88.6404	87.3000	87.3000	87.3000	87.3000	89.2222	89.6585	89.8462	(217)
Fuel for water heating, kWh/month													
	196.3134	172.2230	179.0468	158.1498	153.9826	136.5557	128.1658	144.7599	145.8047	164.2991	176.5725	190.5663	(219)
Water heating fuel used												1946.4397	(219)
Annual totals kWh/year													
Space heating fuel - main system												3784.5421	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												5016.4398	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3784.5421	10.2300	387.1587	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.4397	10.2300	199.1208	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			426.8996	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3784.5421	0.2160	817.4611	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.4397	0.2160	420.4310	(264)
Space and water heating			1237.8921	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			867.0447	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3784.5421	1.2200	4617.1414	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.4397	1.2200	2374.6565	(264)
Space and water heating			6991.7979	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			4798.1536	(272)
Primary energy kWh/m2/year			47.6102	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 90

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-193 kg (22.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 90	A 92
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£186	£204	-£18
Mains gas	£689	£585	£104
Space heating	£518	£518	£0
Water heating	£199	£114	£85
Lighting	£158	£158	£0
Generated (PV)	-£448	-£448	£0
Total cost of fuels	£427	£341	£86
Total cost of uses	£427	£342	£85
Delivered energy	50 kWh/m²	40 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	48 kWh/m²	37 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.1500	
Infiltration rate			0.3994	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5093	0.4993	0.4893	0.4394	0.4294	0.3795	0.3795	0.3695	0.3994	0.4294	0.4494	0.4693	(22b)
Effective ac	0.6297	0.6246	0.6197	0.5965	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6101	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.1336	53.7007	53.2764	51.2833	50.9104	49.1745	49.1745	48.8530	49.8431	50.9104	51.6648	52.4534	(38)
Heat transfer coeff	132.0927	131.6598	131.2354	129.2423	128.8694	127.1335	127.1335	126.8121	127.8022	128.8694	129.6238	130.4125	(39)
Average = Sum(39)m / 12 =												129.2405	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3107	1.3064	1.3022	1.2824	1.2787	1.2615	1.2615	1.2583	1.2681	1.2787	1.2862	1.2940	(40)
HLP (average)												1.2824	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	737.2227	829.9369	934.4703	1046.9931	1115.7676	1094.5007	1045.2588	973.5833	886.1949	779.1455	712.2441	701.4857	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8550	33.9663	34.0762	34.6017	34.7018	35.1756	35.1756	35.2648	34.9916	34.7018	34.4998	34.2912	
alpha	3.2570	3.2644	3.2717	3.3068	3.3135	3.3450	3.3450	3.3510	3.3328	3.3135	3.3000	3.2861	
util living area													
	0.9811	0.9710	0.9478	0.8934	0.7948	0.6457	0.5023	0.5508	0.7673	0.9232	0.9712	0.9838	(86)
MIT	19.1426	19.3523	19.7230	20.2072	20.6065	20.8644	20.9564	20.9402	20.7445	20.2160	19.6010	19.1121	(87)
Th 2	19.8325	19.8358	19.8391	19.8546	19.8575	19.8711	19.8711	19.8736	19.8659	19.8575	19.8517	19.8455	(88)
util rest of house													
	0.9769	0.9645	0.9358	0.8680	0.7448	0.5601	0.3867	0.4345	0.6939	0.8994	0.9637	0.9801	(89)
MIT 2	17.3892	17.6942	18.2283	18.9178	19.4502	19.7650	19.8494	19.8412	19.6397	18.9473	18.0675	17.3531	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6942	17.9826	18.4883	19.1421	19.6514	19.9563	20.0420	20.0323	19.8319	19.1679	18.3342	17.6591	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5442	17.8326	18.3383	18.9921	19.5014	19.8063	19.8920	19.8823	19.6819	19.0179	18.1842	17.5091	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9644	0.9485	0.9148	0.8441	0.7267	0.5547	0.3889	0.4355	0.6800	0.8762	0.9477	0.9690	(94)
Useful gains	710.9979	787.2046	854.8072	883.7736	810.7900	607.0856	406.5483	423.9767	602.5767	682.6812	674.9727	679.7446	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1749.4649	1702.7062	1553.6039	1304.3242	1005.3575	661.8891	418.5188	441.6040	713.3787	1084.8162	1436.7779	1735.6731	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	772.6195	615.2171	519.9047	302.7964	144.7583	0.0000	0.0000	0.0000	0.0000	299.1884	548.4998	785.6108	(98)
Space heating												3988.5950	(98)
Space heating per m2											(98) / (4) =	39.5772	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4407.2872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	772.6195	615.2171	519.9047	302.7964	144.7583	0.0000	0.0000	0.0000	0.0000	299.1884	548.4998	785.6108	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	853.7232	679.7979	574.4804	334.5817	159.9539	0.0000	0.0000	0.0000	0.0000	330.5950	606.0771	868.0782	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9605	89.9899	90.0185	90.0713	90.1378	87.3000	87.3000	87.3000	87.3000	89.7215	89.8751	89.9709	(217)
Fuel for water heating, kWh/month	167.9940	125.0643	98.6745	50.1633	19.7745	2.9152	0.0000	29.5406	55.5649	103.4248	142.8642	166.8460	(219)
Water heating fuel used												962.8264	(219)
Annual totals kWh/year													
Space heating fuel - main system												4407.2872	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4851.3968	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4407.2872	3.4800	153.3736	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.8264	3.4800	33.5064	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			238.4612	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6870	(257)
SAP value	90.4161	
SAP rating (Section 12)	90	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4407.2872	0.2160	951.9740	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.8264	0.2160	207.9705	(264)
Space and water heating			1159.9445	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			890.7305	(272)
CO2 emissions per m2			8.8400	(273)
EI value			91.8125	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.1500	
Infiltration rate			0.3994	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3994	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4194	0.3894	0.3994	0.3795	0.3795	0.3695	0.3595	0.3495	0.3395	0.3695	0.3495	0.3695	(22b)
Effective ac	0.5879	0.5758	0.5798	0.5720	0.5720	0.5683	0.5646	0.5611	0.5576	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.5461	49.5045	49.8431	49.1745	49.1745	48.8530	48.5401	48.2358	47.9400	48.8530	48.2358	48.8530	(38)
Heat transfer coeff	128.5051	127.4636	127.8022	127.1335	127.1335	126.8121	126.4992	126.1948	125.8991	126.8121	126.1948	126.8121	(39)
Average = Sum(39)m / 12 =												126.9385	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2751	1.2648	1.2681	1.2615	1.2615	1.2583	1.2552	1.2522	1.2492	1.2583	1.2522	1.2583	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	25.1925	0.4600	0.0000	0.7700	44.7945	(76)
West	6.3600	25.1925	0.4600	0.0000	0.7700	56.7515	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	131.2602	218.4164	361.6220	528.3806	613.5217	681.4167	643.9682	568.1778	443.4733	279.4029	163.1284	106.1021	(83)
Total gains	766.1516	848.1716	966.4215	1094.5684	1140.0443	1172.7204	1114.9588	1048.4732	946.2474	821.0160	747.7774	723.4355	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8002	35.0845	34.9916	35.1756	35.1756	35.2648	35.3520	35.4373	35.5205	35.2648	35.4373	35.2648	
alpha	3.3200	3.3390	3.3328	3.3450	3.3450	3.3510	3.3568	3.3625	3.3680	3.3510	3.3625	3.3510	
util living area													
	0.9764	0.9664	0.9366	0.8666	0.7488	0.5632	0.4260	0.4491	0.6989	0.8939	0.9607	0.9795	(86)
MIT	19.3307	19.5030	19.8808	20.3490	20.7122	20.9208	20.9767	20.9729	20.8324	20.3864	19.8120	19.3243	(87)
Th 2	19.8604	19.8685	19.8659	19.8711	19.8711	19.8736	19.8761	19.8785	19.8808	19.8736	19.8785	19.8736	(88)
util rest of house													
	0.9711	0.9589	0.9221	0.8357	0.6895	0.4698	0.3105	0.3288	0.6131	0.8612	0.9503	0.9748	(89)
MIT 2	17.6790	17.9319	18.4694	19.1212	19.5906	19.8196	19.8668	19.8675	19.7466	19.1906	18.3874	17.6786	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9663	18.2052	18.7149	19.3348	19.7857	20.0112	20.0598	20.0597	19.9354	19.3986	18.6352	17.9648	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8163	18.0552	18.5649	19.1848	19.6357	19.8612	19.9098	19.9097	19.7854	19.2486	18.4852	17.8148	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9571	0.9421	0.9001	0.8129	0.6755	0.4687	0.3141	0.3323	0.6049	0.8380	0.9320	0.9620	(94)
Useful gains	733.3100	799.0537	869.9232	889.7807	770.0992	549.6398	350.1891	348.3946	572.3839	688.0499	696.9381	695.9687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1659.8167	1625.8200	1478.0153	1231.2566	907.1891	578.4124	355.4424	354.5758	640.2503	995.2966	1335.7957	1625.0756	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	689.3210	555.5870	452.4205	245.8627	101.9949	0.0000	0.0000	0.0000	0.0000	228.5916	459.9774	691.2556	(98)
Space heating												3425.0106	(98)
Space heating per m2											(98) / (4) =	33.9850	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3784.5421	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	689.3210	555.5870	452.4205	245.8627	101.9949	0.0000	0.0000	0.0000	0.0000	228.5916	459.9774	691.2556	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	761.6807	613.9082	499.9121	271.6714	112.7015	0.0000	0.0000	0.0000	0.0000	252.5874	508.2624	763.8183	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9212	89.9442	89.9613	90.0003	89.9119	87.3000	87.3000	87.3000	87.3000	89.5823	89.8037	89.9222	(217)
Fuel for water heating, kWh/month	163.2831	125.2456	98.2080	48.7696	24.6403	0.0000	0.0000	22.1819	49.8346	98.9786	137.4075	163.4102	(219)
Water heating fuel used												931.9593	(219)

Annual totals kWh/year		
Space heating fuel - main system	3784.5421	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =	-1220.7247	(233)
Total delivered energy for all uses	4051.9594	(238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3784.5421	10.2300	387.1587	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	931.9593	10.2300	95.3394	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	431.1826	36.7200	158.3302	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.7200	-448.2501	(252)
Total energy cost			341.4782	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3784.5421	0.2160	817.4611	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.9593	0.2160	201.3032	(264)
Space and water heating			1018.7643	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

PV Unit	-1220.7247	0.5190	-633.5561 (269)
Total kg/year			673.8670 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3784.5421	1.2200	4617.1414	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	931.9593	1.2200	1136.9904	(264)
Space and water heating			5754.1318	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			3713.9875	(272)
Primary energy kWh/m2/year			36.8524	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		77.96 (37)
Summer heat loss coefficient		421.84 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0200	117.5071	0.4600	0.0000	0.9000	244.2126
West	6.3600	117.5071	0.4600	0.0000	0.9000	309.4008
East	3.3300	117.5071	0.4600	0.0000	0.9000	161.9976
total:						715.6110

	Jun	Jul	Aug	
Solar gains	760	716	630	(P4)
Internal gains	488	468	477	
Total summer gains	1248	1184	1107	(P5)
Summer gain/loss ratio	2.96	2.81	2.62	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.84	21.59	21.31	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-335	**Issued on Date**	25/08/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	21, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.27	**TER**	18.91
Environmental	91 B	**% DER<TER**	40.40		
CO_2 Emissions (t/year)	0.72	**DFEE**	51.85	**TFEE**	58.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.12		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.27 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.51 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.64 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 5.06 m², No overhang
Windows facing North West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617 (8)
Pressure test				Yes
Measured/design AP50				4.5100
Infiltration rate				0.3872 (18)
Number of sides sheltered				0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3872 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4936	0.4840	0.4743	0.4259	0.4162	0.3678	0.3678	0.3581	0.3872	0.4162	0.4356	0.4549	(22b)
Effective ac	0.6218	0.6171	0.6125	0.5907	0.5866	0.5676	0.5676	0.5641	0.5750	0.5866	0.5949	0.6035	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7706	50.3843	50.0057	48.2272	47.8945	46.3455	46.3455	46.0586	46.9421	47.8945	48.5676	49.2714	(38)
Heat transfer coeff	124.5553	124.1690	123.7903	122.0119	121.6791	120.1301	120.1301	119.8433	120.7268	121.6791	122.3523	123.0560	(39)
Average = Sum(39)m / 12 =												122.0103	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3014	1.2973	1.2934	1.2748	1.2713	1.2551	1.2551	1.2521	1.2614	1.2713	1.2784	1.2857	(40)
HLP (average)												1.2748	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	524.3049	609.5632	696.1878	792.4241	862.8713	855.1620	812.5483	744.7959	668.1159	578.2939	513.9022	494.7120	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0150	36.1270	36.2375	36.7657	36.8663	37.3416	37.3416	37.4310	37.1571	36.8663	36.6634	36.4538	
alpha	3.4010	3.4085	3.4158	3.4510	3.4578	3.4894	3.4894	3.4954	3.4771	3.4578	3.4442	3.4303	
util living area													
	0.9931	0.9878	0.9755	0.9423	0.8674	0.7342	0.5912	0.6496	0.8535	0.9627	0.9886	0.9944	(86)
MIT	19.0143	19.2194	19.5765	20.0650	20.5086	20.8185	20.9380	20.9130	20.6622	20.0910	19.4730	18.9864	(87)
Th 2	19.8398	19.8429	19.8460	19.8606	19.8634	19.8761	19.8761	19.8785	19.8712	19.8634	19.8578	19.8520	(88)
util rest of house													
	0.9914	0.9848	0.9691	0.9258	0.8268	0.6499	0.4637	0.5247	0.7926	0.9489	0.9853	0.9930	(89)
MIT 2	17.1992	17.4997	18.0196	18.7276	19.3377	19.7290	19.8444	19.8293	19.5565	18.7769	17.8801	17.1660	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.4754	17.7613	18.2564	18.9311	19.5158	19.8948	20.0108	19.9942	19.7247	18.9768	18.1225	17.4429	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3254	17.6113	18.1064	18.7811	19.3658	19.7448	19.8608	19.8442	19.5747	18.8268	17.9725	17.2929	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9757	0.9548	0.9048	0.8049	0.6386	0.4617	0.5204	0.7724	0.9307	0.9765	0.9879	(94)
Useful gains	516.6372	594.7272	664.6977	716.9475	694.4969	546.1173	375.1882	387.6118	516.0734	538.1932	501.8089	488.7087	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1622.3765	1578.3509	1436.7620	1205.6061	932.7691	618.0405	391.7169	412.7629	660.9397	1001.0311	1330.2689	1611.1639	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	822.6700	660.9951	574.4159	351.8342	177.2745	0.0000	0.0000	0.0000	0.0000	344.3514	596.4912	835.1067	(98)
Space heating												4363.1389	(98)
Space heating per m2											(98) / (4) =	45.5871	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4821.1480	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	822.6700	660.9951	574.4159	351.8342	177.2745	0.0000	0.0000	0.0000	0.0000	344.3514	596.4912	835.1067	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	909.0277	730.3813	634.7137	388.7670	195.8834	0.0000	0.0000	0.0000	0.0000	380.4988	659.1063	922.7698	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9235	89.8810	89.7875	89.5670	89.0882	87.3000	87.3000	87.3000	87.3000	89.5277	89.8155	89.9442	(217)
Fuel for water heating, kWh/month													
	193.9256	170.1267	176.7796	155.9608	151.5424	135.0886	126.8064	143.1997	144.2255	161.9479	174.3155	188.2459	(219)
Water heating fuel used												1922.1647	(219)
Annual totals kWh/year													
Space heating fuel - main system												4821.1480	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												6015.8349	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4821.1480	0.2160	1041.3680	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.1647	0.2160	415.1876	(264)
Space and water heating			1456.5555	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1078.9946	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.2700	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		28.6184	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.6184	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	93.8213	169.3875	257.1968	361.3096	443.6078	457.5155	433.9710	369.9562	292.8388	194.0668	114.1200	79.1631	(83)
Total gains	521.7605	595.0093	667.6822	746.7429	803.4444	792.8644	754.0017	697.0857	633.3314	559.8359	508.1408	494.5022	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9987	0.9972	0.9930	0.9769	0.9235	0.7923	0.6299	0.6923	0.9064	0.9865	0.9974	0.9990	(86)
MIT	19.6045	19.7474	20.0006	20.3539	20.6822	20.9042	20.9761	20.9626	20.7926	20.3748	19.9324	19.5857	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9982	0.9963	0.9903	0.9670	0.8888	0.7030	0.4929	0.5574	0.8494	0.9791	0.9963	0.9986	(89)
MIT 2	18.0367	18.2476	18.6187	19.1377	19.5910	19.8630	19.9220	19.9169	19.7460	19.1746	18.5281	18.0172	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2752	18.4757	18.8289	19.3227	19.7570	20.0214	20.0823	20.0760	19.9053	19.3572	18.7417	18.2558	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2752	18.4757	18.8289	19.3227	19.7570	20.0214	20.0823	20.0760	19.9053	19.3572	18.7417	18.2558	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9943	0.9864	0.9597	0.8823	0.7115	0.5135	0.5771	0.8480	0.9734	0.9944	0.9978	(94)
Useful gains	520.2596	591.6178	658.5898	716.6269	708.8999	564.1454	387.1733	402.3037	537.0570	544.9571	505.2747	493.4047	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1643.1860	1591.3910	1440.9427	1201.1078	926.0214	615.3823	395.2766	416.2898	662.1369	1006.4960	1345.2364	1633.2807	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	835.4572	671.8476	582.0706	348.8262	161.5384	0.0000	0.0000	0.0000	0.0000	343.3849	604.7724	848.0678	(98)
Space heating												4395.9651	(98)
Space heating per m2											(98) / (4) =	45.9301	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4706.6008	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	835.4572	671.8476	582.0706	348.8262	161.5384	0.0000	0.0000	0.0000	0.0000	343.3849	604.7724	848.0678	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	894.4938	719.3229	623.2019	373.4756	172.9533	0.0000	0.0000	0.0000	0.0000	367.6498	647.5079	907.9955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1624	87.9984	87.6280	86.7738	84.9521	80.3000	80.3000	80.3000	80.3000	86.6272	87.7384	88.2300	(217)
Fuel for water heating, kWh/month													
	239.5607	211.5692	223.1948	200.0140	197.8014	184.3053	176.5785	196.8436	199.0176	209.9529	219.0850	233.6465	(219)
Water heating fuel used												2491.5695	(219)
Annual totals kWh/year													
Space heating fuel - main system												4706.6008	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7689.2497	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4706.6008	0.2160	1016.6258	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2491.5695	0.2160	538.1790	(264)
Space and water heating			1554.8048	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1809.6750	(272)
Emissions per m2 for space and water heating			16.2450	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2450 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			4.5100	
Infiltration rate			0.3468	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3468	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4421	0.4334	0.4248	0.3814	0.3728	0.3294	0.3294	0.3207	0.3468	0.3728	0.3901	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5543	0.5543	0.5514	0.5601	0.5695	0.5761	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.8020	48.4922	48.1885	46.7619	46.4950	45.2526	45.2526	45.0225	45.7311	46.4950	47.0350	47.5994	(38)
Heat transfer coeff	122.5867	122.2768	121.9731	120.5466	120.2797	119.0372	119.0372	118.8071	119.5158	120.2797	120.8196	121.3841	(39)
Average = Sum(39)m / 12 =												120.5453	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2808	1.2776	1.2744	1.2595	1.2567	1.2437	1.2437	1.2413	1.2487	1.2567	1.2624	1.2682	(40)
HLP (average)												1.2595	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	490.7074	576.7888	665.1225	763.6862	835.6455	830.0629	789.2535	719.1858	641.6805	549.4501	482.3428	461.9342	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.5933	36.6861	36.7774	37.2126	37.2952	37.6845	37.6845	37.7575	37.5336	37.2952	37.1285	36.9559	
alpha	3.4396	3.4457	3.4518	3.4808	3.4863	3.5123	3.5123	3.5172	3.5022	3.4863	3.4752	3.4637	
util living area													
	0.9944	0.9897	0.9784	0.9470	0.8746	0.7439	0.6009	0.6622	0.8638	0.9673	0.9906	0.9955	(86)
MIT	19.0048	19.2099	19.5674	20.0542	20.5010	20.8136	20.9361	20.9092	20.6514	20.0741	19.4557	18.9729	(87)
Th 2	19.8559	19.8584	19.8609	19.8727	19.8749	19.8852	19.8852	19.8871	19.8812	19.8749	19.8704	19.8658	(88)
util rest of house													
	0.9930	0.9871	0.9727	0.9317	0.8356	0.6608	0.4733	0.5378	0.8057	0.9552	0.9878	0.9944	(89)
MIT 2	18.0393	18.2452	18.6015	19.0866	19.5081	19.7811	19.8626	19.8515	19.6569	19.1146	18.4998	18.0147	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1861	18.3920	18.7484	19.2338	19.6592	19.9382	20.0259	20.0124	19.8082	19.2606	18.6452	18.1605	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1861	18.3920	18.7484	19.2338	19.6592	19.9382	20.0259	20.0124	19.8082	19.2606	18.6452	18.1605	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9824	0.9651	0.9207	0.8267	0.6653	0.4908	0.5534	0.8011	0.9461	0.9835	0.9919	(94)
Useful gains	485.8453	566.6586	641.8995	703.1112	690.8214	552.2264	387.3864	397.9921	514.0399	519.8578	474.3975	458.1977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1702.2562	1649.7573	1493.9787	1245.7067	957.3258	635.4419	407.8106	429.1827	682.2234	1041.6899	1394.8882	1694.5828	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	905.0097	727.8423	633.9469	390.6688	198.2793	0.0000	0.0000	0.0000	0.0000	388.2430	662.7534	919.8705	(98)
Space heating												4826.6139	(98)
Space heating per m2											(98) / (4) =	50.4296	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1118.9498	880.8753	902.9341	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7619	0.8328	0.7954	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	852.5575	733.5822	718.2387	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1073.3752	1023.5254	943.6094	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	158.9887	215.7178	167.6758	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												542.3823	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.7472	53.9294	41.9190	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												135.5956	(107)
Space cooling per m2												1.4167	(108)
Energy for space heating												50.4296	(99)
Energy for space cooling												1.4167	(108)
Total												51.8463	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	93.8213	169.3875	257.1968	361.3096	443.6078	457.5155	433.9710	369.9562	292.8388	194.0668	114.1200	79.1631	(83)
Total gains	475.7915	549.8592	624.2328	706.2444	765.1198	757.3261	720.2599	660.3693	595.1244	518.5969	464.1998	449.3487	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9991	0.9980	0.9947	0.9814	0.9347	0.8129	0.6535	0.7200	0.9228	0.9901	0.9982	0.9993	(86)
MIT	19.5603	19.7042	19.9598	20.3185	20.6561	20.8919	20.9720	20.9556	20.7684	20.3371	19.8902	19.5421	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9988	0.9973	0.9926	0.9732	0.9037	0.7262	0.5142	0.5845	0.8724	0.9845	0.9975	0.9991	(89)
MIT 2	18.5829	18.7289	18.9859	19.3510	19.6731	19.8775	19.9236	19.9196	19.7851	19.3743	18.9259	18.5737	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7316	18.8773	19.1341	19.4982	19.8226	20.0318	20.0831	20.0772	19.9347	19.5208	19.0726	18.7210	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7316	18.8773	19.1341	19.4982	19.8226	20.0318	20.0831	20.0772	19.9347	19.5208	19.0726	18.7210	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9964	0.9906	0.9691	0.9002	0.7356	0.5355	0.6047	0.8729	0.9816	0.9966	0.9987	(94)
Useful gains	474.9945	547.8782	618.3693	684.3915	688.7674	557.0906	385.6696	399.3416	519.4836	509.0565	462.6257	448.7831	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1696.8392	1638.4601	1476.6080	1221.3360	933.5651	616.5623	395.3676	416.4294	665.4908	1025.3023	1383.4636	1687.3436	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	909.0525	732.8710	638.5296	386.6001	182.1295	0.0000	0.0000	0.0000	0.0000	384.0869	663.0033	921.4890	(98)
Space heating												4817.7619	(98)
Space heating per m2											(98) / (4) =	50.3371	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7973	0.8748	0.8376	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	850.7337	734.7928	720.8928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	988.3582	942.8835	874.8630	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	99.0897	154.8195	114.5538	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												368.4630 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.7724	38.7049	28.6384	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												92.1157 (107)
Space cooling per m2												0.9624 (108)
Energy for space heating												50.3371 (99)
Energy for space cooling												0.9624 (108)
Total												51.2995 (109)
Target Fabric Energy Efficiency (TFEE)												59.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5100	
Infiltration rate		0.3872	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3872	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4065	0.3775	0.3872	0.3678	0.3678	0.3581	0.3485	0.3388	0.3291	0.3581	0.3388	0.3581	(22b)
Effective ac	0.5826	0.5713	0.5750	0.5676	0.5676	0.5641	0.5607	0.5574	0.5542	0.5641	0.5574	0.5641	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5694	46.6400	46.9421	46.3455	46.3455	46.0586	45.7794	45.5079	45.2440	46.0586	45.5079	46.0586	(38)
Heat transfer coeff	121.3540	120.4246	120.7268	120.1301	120.1301	119.8433	119.5641	119.2925	119.0286	119.8433	119.2925	119.8433	(39)
Average = Sum(39)m / 12 =												119.9561	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2679	1.2582	1.2614	1.2551	1.2551	1.2521	1.2492	1.2464	1.2436	1.2521	1.2464	1.2521	(40)
HLP (average)												1.2533	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	14.6176	0.4600	0.0000	0.7700	22.3153	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Northeast	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(75)

Solar gains	135.7760	209.5380	322.9602	459.3542	537.4410	602.3566	566.8123	494.3921	389.4700	259.6675	164.8067	112.4969	(83)
Total gains	753.7774	822.5402	911.7462	1010.6774	1050.3246	1081.0555	1025.7517	962.4488	879.2958	787.1805	734.0896	713.4606	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9650	37.2503	37.1571	37.3416	37.3416	37.4310	37.5184	37.6038	37.6872	37.4310	37.6038	37.4310	
alpha	3.4643	3.4834	3.4771	3.4894	3.4894	3.4954	3.5012	3.5069	3.5125	3.4954	3.5069	3.4954	
util living area													
	0.9770	0.9681	0.9425	0.8804	0.7662	0.5783	0.4384	0.4631	0.7128	0.8976	0.9612	0.9799	(86)
MIT	19.4375	19.5921	19.9319	20.3670	20.7214	20.9254	20.9786	20.9748	20.8411	20.4280	19.8942	19.4303	(87)
Th 2	19.8660	19.8737	19.8712	19.8761	19.8761	19.8785	19.8808	19.8831	19.8852	19.8785	19.8831	19.8785	(88)
util rest of house													
	0.9716	0.9608	0.9287	0.8508	0.7071	0.4830	0.3199	0.3395	0.6262	0.8648	0.9506	0.9752	(89)
MIT 2	17.8286	18.0558	18.5397	19.1471	19.6058	19.8285	19.8725	19.8731	19.7594	19.2457	18.5004	17.8267	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.0733	18.2895	18.7515	19.3327	19.7755	19.9954	20.0408	20.0407	19.9240	19.4255	18.7125	18.0706	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9233	18.1395	18.6015	19.1827	19.6255	19.8454	19.8908	19.8907	19.7740	19.2755	18.5625	17.9206	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9582	0.9448	0.9081	0.8284	0.6921	0.4800	0.3210	0.3404	0.6164	0.8422	0.9328	0.9629	(94)
Useful gains	722.2907	777.1421	827.9644	837.2540	726.9117	518.9254	329.2384	327.6084	542.0280	662.9664	684.7881	687.0122	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1580.4345	1546.1935	1400.6159	1163.1829	855.9858	544.7306	333.6809	332.9144	603.9476	943.8294	1271.9507	1548.4502	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	638.4589	516.8025	426.0528	234.6688	96.0311	0.0000	0.0000	0.0000	0.0000	208.9620	422.7571	640.9099	(98)
Space heating												3184.6432	(98)
RHI space heating demand												3185	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.5100	
Infiltration rate			0.3872	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3872	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4936	0.4840	0.4743	0.4259	0.4162	0.3678	0.3678	0.3581	0.3872	0.4162	0.4356	0.4549	(22b)
Effective ac	0.6218	0.6171	0.6125	0.5907	0.5866	0.5676	0.5676	0.5641	0.5750	0.5866	0.5949	0.6035	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7706	50.3843	50.0057	48.2272	47.8945	46.3455	46.3455	46.0586	46.9421	47.8945	48.5676	49.2714	(38)
Heat transfer coeff	124.5553	124.1690	123.7903	122.0119	121.6791	120.1301	120.1301	119.8433	120.7268	121.6791	122.3523	123.0560	(39)
Average = Sum(39)m / 12 =												122.0103	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3014	1.2973	1.2934	1.2748	1.2713	1.2551	1.2551	1.2521	1.2614	1.2713	1.2784	1.2857	(40)
HLP (average)												1.2748	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
								Total per year (kWh/year) = Sum(64)m =				1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	726.7387	809.3193	886.8726	970.0746	1027.0171	1008.9512	961.9041	896.8294	829.2207	752.4329	701.5460	692.7124	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0150	36.1270	36.2375	36.7657	36.8663	37.3416	37.3416	37.4310	37.1571	36.8663	36.6634	36.4538	
alpha	3.4010	3.4085	3.4158	3.4510	3.4578	3.4894	3.4894	3.4954	3.4771	3.4578	3.4442	3.4303	
util living area													
	0.9816	0.9722	0.9524	0.9048	0.8117	0.6623	0.5166	0.5660	0.7784	0.9255	0.9716	0.9842	(86)
MIT	19.2597	19.4548	19.7876	20.2329	20.6178	20.8705	20.9593	20.9437	20.7589	20.2701	19.6952	19.2291	(87)
Th 2	19.8398	19.8429	19.8460	19.8606	19.8634	19.8761	19.8761	19.8785	19.8712	19.8634	19.8578	19.8520	(88)
util rest of house													
	0.9774	0.9658	0.9409	0.8807	0.7626	0.5755	0.3983	0.4472	0.7048	0.9016	0.9639	0.9806	(89)
MIT 2	17.5545	17.8382	18.3181	18.9542	19.4686	19.7760	19.8564	19.8486	19.6598	19.0203	18.1988	17.5180	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8139	18.0842	18.5417	19.1487	19.6434	19.9425	20.0242	20.0152	19.8270	19.2105	18.4264	17.7783	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6639	17.9342	18.3917	18.9987	19.4934	19.7925	19.8742	19.8652	19.6770	19.0605	18.2764	17.6283	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9655	0.9506	0.9212	0.8578	0.7438	0.5684	0.3980	0.4457	0.6899	0.8791	0.9485	0.9699	(94)
Useful gains	701.6439	769.3130	816.9644	832.0863	763.8883	573.4983	382.8764	399.6738	572.1181	661.4464	665.3896	671.8802	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1664.5494	1618.4379	1472.0745	1232.1666	948.2981	623.7731	393.3259	415.2831	673.2964	1029.4618	1367.4586	1652.4356	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	716.4017	570.6119	487.4019	288.0578	137.2009	0.0000	0.0000	0.0000	0.0000	273.8034	505.4896	729.5333	(98)
Space heating												3708.5006	(98)
Space heating per m2											(98) / (4) =	38.7473	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4097.7907	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	716.4017	570.6119	487.4019	288.0578	137.2009	0.0000	0.0000	0.0000	0.0000	273.8034	505.4896	729.5333	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	791.6041	630.5104	538.5657	318.2959	151.6032	0.0000	0.0000	0.0000	0.0000	302.5452	558.5521	806.1141	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8552	89.8043	89.6924	89.4295	88.8841	87.3000	87.3000	87.3000	87.3000	89.3659	89.7223	89.8794	(217)
Fuel for water heating, kWh/month													
	194.0730	170.2721	176.9671	156.2005	151.8904	135.0886	126.8064	143.1997	144.2255	162.2410	174.4967	188.3817	(219)
Water heating fuel used												1923.8427	(219)
Annual totals kWh/year													
Space heating fuel - main system												4097.7907	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5294.1557	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4097.7907	3.4800	142.6031	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.8427	3.4800	66.9497	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			233.5985	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6973	(257)
SAP value		90.2732	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4097.7907	0.2160	885.1228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.8427	0.2160	415.5500	(264)
Space and water heating			1300.6728	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			923.1119	(272)
CO2 emissions per m2			9.6400	(273)
EI value			91.2091	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5100	
Infiltration rate		0.3872	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3872	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4065	0.3775	0.3872	0.3678	0.3678	0.3581	0.3485	0.3388	0.3291	0.3581	0.3388	0.3581	(22b)
Effective ac	0.5826	0.5713	0.5750	0.5676	0.5676	0.5641	0.5607	0.5574	0.5542	0.5641	0.5574	0.5641	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5694	46.6400	46.9421	46.3455	46.3455	46.0586	45.7794	45.5079	45.2440	46.0586	45.5079	46.0586	(38)
Heat transfer coeff	121.3540	120.4246	120.7268	120.1301	120.1301	119.8433	119.5641	119.2925	119.0286	119.8433	119.2925	119.8433	(39)
Average = Sum(39)m / 12 =												119.9561	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2679	1.2582	1.2614	1.2551	1.2551	1.2521	1.2492	1.2464	1.2436	1.2521	1.2464	1.2521	(40)
HLP (average)												1.2533	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	14.6176	0.4600	0.0000	0.7700	22.3153	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Northeast	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(75)

Solar gains	135.7760	209.5380	322.9602	459.3542	537.4410	602.3566	566.8123	494.3921	389.4700	259.6675	164.8067	112.4969	(83)
Total gains	753.7774	822.5402	911.7462	1010.6774	1050.3246	1081.0555	1025.7517	962.4488	879.2958	787.1805	734.0896	713.4606	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9650	37.2503	37.1571	37.3416	37.3416	37.4310	37.5184	37.6038	37.6872	37.4310	37.6038	37.4310	
alpha	3.4643	3.4834	3.4771	3.4894	3.4894	3.4954	3.5012	3.5069	3.5125	3.4954	3.5069	3.4954	
util living area													
	0.9770	0.9681	0.9425	0.8804	0.7662	0.5783	0.4384	0.4631	0.7128	0.8976	0.9612	0.9799	(86)
MIT	19.4375	19.5921	19.9319	20.3670	20.7214	20.9254	20.9786	20.9748	20.8411	20.4280	19.8942	19.4303	(87)
Th 2	19.8660	19.8737	19.8712	19.8761	19.8761	19.8785	19.8808	19.8831	19.8852	19.8785	19.8831	19.8785	(88)
util rest of house													
	0.9716	0.9608	0.9287	0.8508	0.7071	0.4830	0.3199	0.3395	0.6262	0.8648	0.9506	0.9752	(89)
MIT 2	17.8286	18.0558	18.5397	19.1471	19.6058	19.8285	19.8725	19.8731	19.7594	19.2457	18.5004	17.8267	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.0733	18.2895	18.7515	19.3327	19.7755	19.9954	20.0408	20.0407	19.9240	19.4255	18.7125	18.0706	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9233	18.1395	18.6015	19.1827	19.6255	19.8454	19.8908	19.8907	19.7740	19.2755	18.5625	17.9206	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9582	0.9448	0.9081	0.8284	0.6921	0.4800	0.3210	0.3404	0.6164	0.8422	0.9328	0.9629	(94)
Useful gains	722.2907	777.1421	827.9644	837.2540	726.9117	518.9254	329.2384	327.6084	542.0280	662.9664	684.7881	687.0122	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1580.4345	1546.1935	1400.6159	1163.1829	855.9858	544.7306	333.6809	332.9144	603.9476	943.8294	1271.9507	1548.4502	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	638.4589	516.8025	426.0528	234.6688	96.0311	0.0000	0.0000	0.0000	0.0000	208.9620	422.7571	640.9099	(98)
Space heating												3184.6432	(98)
Space heating per m2											(98) / (4) =	33.2739	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3518.9428	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	638.4589	516.8025	426.0528	234.6688	96.0311	0.0000	0.0000	0.0000	0.0000	208.9620	422.7571	640.9099	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	705.4795	571.0525	470.7765	259.3026	106.1118	0.0000	0.0000	0.0000	0.0000	230.8972	467.1349	708.1877	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7939	89.7489	89.6085	89.2789	88.6022	87.3000	87.3000	87.3000	87.3000	89.1612	89.6123	89.8120	(217)
Fuel for water heating, kWh/month													
	194.2056	170.3773	177.1328	156.4640	152.3737	135.0886	126.8064	143.1997	144.2255	162.6135	174.7108	188.5230	(219)
Water heating fuel used												1925.7208	(219)
Annual totals kWh/year													
Space heating fuel - main system												3518.9428	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4566.7658	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3518.9428	10.2300	359.9878	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1925.7208	10.2300	197.0012	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			337.6250	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3518.9428	0.2160	760.0916	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.7208	0.2160	415.9557	(264)
Space and water heating			1176.0473	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			720.4184	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3518.9428	1.2200	4293.1102	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.7208	1.2200	2349.3794	(264)
Space and water heating			6642.4896	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3947.3434	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 41.2427 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 85	-192 kg (26.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.00 kg/m²	B 91	A 93
Total Savings	£85	2.00 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£180	£199	-£18
Mains gas	£660	£557	£103
Space heating	£491	£491	£0
Water heating	£197	£112	£85
Lighting	£153	£153	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£337	£253	£85
Total cost of uses	£338	£253	£85
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	30 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5100	
Infiltration rate		0.3872	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3872	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4936	0.4840	0.4743	0.4259	0.4162	0.3678	0.3678	0.3581	0.3872	0.4162	0.4356	0.4549	(22b)
Effective ac	0.6218	0.6171	0.6125	0.5907	0.5866	0.5676	0.5676	0.5641	0.5750	0.5866	0.5949	0.6035	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.7706	50.3843	50.0057	48.2272	47.8945	46.3455	46.3455	46.0586	46.9421	47.8945	48.5676	49.2714	(38)
Heat transfer coeff	124.5553	124.1690	123.7903	122.0119	121.6791	120.1301	120.1301	119.8433	120.7268	121.6791	122.3523	123.0560	(39)
Average = Sum(39)m / 12 =												122.0103	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3014	1.2973	1.2934	1.2748	1.2713	1.2551	1.2551	1.2521	1.2614	1.2713	1.2784	1.2857	(40)
HLP (average)												1.2748	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)

Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.7000 (H2)
Collector heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0050 (H3a)
Collector effective heat loss coefficient 1.8063 (H3b)
Collector performance ratio 2.5804 (H4)
Annual solar radiation per m2 1079.5246 (H5)
Overshading factor 0.8000 (H6)
Solar energy available 1813.6014 (H7)
Adjustment factor for showers 1.0000 (H7a)
Solar-to-load ratio 1.1734 (H8)
Utilisation factor 0.5735 (H9)
Collector performance factor 0.8793 (H10)
Dedicated solar storage volume 75.0000 (H11)
Effective solar volume 75.0000 (H13)
Daily hot water demand 98.2325 (H14)
Volume ratio Veff/V 0.7635 (H15)
Solar storage volume factor 0.9460 (H16)
Solar input -865.2421 (H17)
Solar input

	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963 (63)

Solar input (sum of months) = Sum(63)m = -865.2421 (63)
Output from w/h

	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200 (64)

Total per year (kWh/year) = Sum(64)m = 849.7380 (64)
Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)
Total internal gains												
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487 (83)
Total gains	726.7387	809.3193	886.8726	970.0746	1027.0171	1008.9512	961.9041	896.8294	829.2207	752.4329	701.5460	692.7124 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0150	36.1270	36.2375	36.7657	36.8663	37.3416	37.3416	37.4310	37.1571	36.8663	36.6634	36.4538	
alpha	3.4010	3.4085	3.4158	3.4510	3.4578	3.4894	3.4894	3.4954	3.4771	3.4578	3.4442	3.4303	
util living area													
	0.9816	0.9722	0.9524	0.9048	0.8117	0.6623	0.5166	0.5660	0.7784	0.9255	0.9716	0.9842	(86)
MIT	19.2597	19.4548	19.7876	20.2329	20.6178	20.8705	20.9593	20.9437	20.7589	20.2701	19.6952	19.2291	(87)
Th 2	19.8398	19.8429	19.8460	19.8606	19.8634	19.8761	19.8761	19.8785	19.8712	19.8634	19.8578	19.8520	(88)
util rest of house													
	0.9774	0.9658	0.9409	0.8807	0.7626	0.5755	0.3983	0.4472	0.7048	0.9016	0.9639	0.9806	(89)
MIT 2	17.5545	17.8382	18.3181	18.9542	19.4686	19.7760	19.8564	19.8486	19.6598	19.0203	18.1988	17.5180	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8139	18.0842	18.5417	19.1487	19.6434	19.9425	20.0242	20.0152	19.8270	19.2105	18.4264	17.7783	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6639	17.9342	18.3917	18.9987	19.4934	19.7925	19.8742	19.8652	19.6770	19.0605	18.2764	17.6283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9655	0.9506	0.9212	0.8578	0.7438	0.5684	0.3980	0.4457	0.6899	0.8791	0.9485	0.9699	(94)
Useful gains	701.6439	769.3130	816.9644	832.0863	763.8883	573.4983	382.8764	399.6738	572.1181	661.4464	665.3896	671.8802	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1664.5494	1618.4379	1472.0745	1232.1666	948.2981	623.7731	393.3259	415.2831	673.2964	1029.4618	1367.4586	1652.4356	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	716.4017	570.6119	487.4019	288.0578	137.2009	0.0000	0.0000	0.0000	0.0000	273.8034	505.4896	729.5333	(98)

Space heating 3708.5006 (98)
Space heating per m2 (98) / (4) = 38.7473 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4097.7907 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	716.4017	570.6119	487.4019	288.0578	137.2009	0.0000	0.0000	0.0000	0.0000	273.8034	505.4896	729.5333	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	791.6041	630.5104	538.5657	318.2959	151.6032	0.0000	0.0000	0.0000	0.0000	302.5452	558.5521	806.1141	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9315	89.9628	89.9983	90.0615	90.1368	87.3000	87.3000	87.3000	87.3000	89.6769	89.8396	89.9430	(217)
Fuel for water heating, kWh/month	166.0090	123.4323	97.1342	48.9933	18.7977	2.1281	0.0000	28.5666	54.4449	101.9938	141.1423	164.9045	(219)

Water heating fuel used 947.5469 (219)
Annual totals kWh/year
Space heating fuel - main system 4097.7907 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 4367.8599 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4097.7907	3.4800	142.6031	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.5469	3.4800	32.9746	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			206.2184	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.6155 (257)
SAP value 91.4133
SAP rating (Section 12) 91 (258)
SAP band B

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4097.7907	0.2160	885.1228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.5469	0.2160	204.6701	(264)
Space and water heating			1089.7929	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			738.1820	(272)
CO2 emissions per m2			7.7100	(273)
EI value			92.9702	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.5100	
Infiltration rate		0.3872	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3872	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4065	0.3775	0.3872	0.3678	0.3678	0.3581	0.3485	0.3388	0.3291	0.3581	0.3388	0.3581	(22b)
Effective ac	0.5826	0.5713	0.5750	0.5676	0.5676	0.5641	0.5607	0.5574	0.5542	0.5641	0.5574	0.5641	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.5694	46.6400	46.9421	46.3455	46.3455	46.0586	45.7794	45.5079	45.2440	46.0586	45.5079	46.0586	(38)
Heat transfer coeff	121.3540	120.4246	120.7268	120.1301	120.1301	119.8433	119.5641	119.2925	119.0286	119.8433	119.2925	119.8433	(39)
Average = Sum(39)m / 12 =												119.9561	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2679	1.2582	1.2614	1.2551	1.2551	1.2521	1.2492	1.2464	1.2436	1.2521	1.2464	1.2521	(40)
HLP (average)												1.2533	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                          Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3132 (H8)
Utilisation factor                                                                                                                  0.5330 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             98.2325 (H14)
Volume ratio Veff/V                                                                                                                 0.7635 (H15)
Solar storage volume factor                                                                                                         0.9460 (H16)
Solar input                                                                                                                      -899.9506 (H17)
Solar input    -29.3586   -41.7460   -71.7514   -96.8092  -113.7082  -121.4583  -118.9041  -106.4227   -83.3217   -57.6057   -34.7234   -24.1413 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -899.9506 (63)
Output from w/h
              145.0261   111.1657    86.9746    42.8801    21.2982     0.0000     0.0000    18.5906    42.5872    87.3824   121.8389   145.1750 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =    822.9189 (64)
Heat gains from water heating, kWh/month
              56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)


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6. Solar gains
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[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                          m2          Table 6a    Specific data  Specific data      factor               W
                                                         W/m2    or Table 6b    or Table 6c    Table 6d
-------------------------------------------------------------------------------------------------------------------
Northeast                                4.3100         14.6176         0.4600         0.0000         0.7700         22.3153 (75)
Southeast                                0.7200         45.1778         0.4600         0.0000         0.7700         11.5214 (77)
Southwest                                5.0600         45.1778         0.4600         0.0000         0.7700         80.9700 (79)
Northwest                                0.7200         14.6176         0.4600         0.0000         0.7700          3.7279 (81)
Northeast                                3.3300         14.6176         0.4600         0.0000         0.7700         17.2413 (75)
-------------------------------------------------------------------------------------------------------------------

Solar gains    135.7760   209.5380   322.9602   459.3542   537.4410   602.3566   566.8123   494.3921   389.4700   259.6675   164.8067   112.4969 (83)
Total gains    753.7774   822.5402   911.7462  1010.6774  1050.3246  1081.0555  1025.7517   962.4488   879.2958   787.1805   734.0896   713.4606 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.9650    37.2503    37.1571    37.3416    37.3416    37.4310    37.5184    37.6038    37.6872    37.4310    37.6038    37.4310
alpha          3.4643     3.4834     3.4771     3.4894     3.4894     3.4954     3.5012     3.5069     3.5125     3.4954     3.5069     3.4954
util living area
               0.9770     0.9681     0.9425     0.8804     0.7662     0.5783     0.4384     0.4631     0.7128     0.8976     0.9612     0.9799 (86)

MIT           19.4375    19.5921    19.9319    20.3670    20.7214    20.9254    20.9786    20.9748    20.8411    20.4280    19.8942    19.4303 (87)
Th 2          19.8660    19.8737    19.8712    19.8761    19.8761    19.8785    19.8808    19.8831    19.8852    19.8785    19.8831    19.8785 (88)
util rest of house
               0.9716     0.9608     0.9287     0.8508     0.7071     0.4830     0.3199     0.3395     0.6262     0.8648     0.9506     0.9752 (89)
MIT 2         17.8286    18.0558    18.5397    19.1471    19.6058    19.8285    19.8725    19.8731    19.7594    19.2457    18.5004    17.8267 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1521 (91)
MIT           18.0733    18.2895    18.7515    19.3327    19.7755    19.9954    20.0408    20.0407    19.9240    19.4255    18.7125    18.0706 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.9233    18.1395    18.6015    19.1827    19.6255    19.8454    19.8908    19.8907    19.7740    19.2755    18.5625    17.9206 (93)
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9582	0.9448	0.9081	0.8284	0.6921	0.4800	0.3210	0.3404	0.6164	0.8422	0.9328	0.9629	(94)
Useful gains	722.2907	777.1421	827.9644	837.2540	726.9117	518.9254	329.2384	327.6084	542.0280	662.9664	684.7881	687.0122	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1580.4345	1546.1935	1400.6159	1163.1829	855.9858	544.7306	333.6809	332.9144	603.9476	943.8294	1271.9507	1548.4502	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	638.4589	516.8025	426.0528	234.6688	96.0311	0.0000	0.0000	0.0000	0.0000	208.9620	422.7571	640.9099	(98)
Space heating												3184.6432	(98)
Space heating per m2											(98) / (4) =	33.2739	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3518.9428	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	638.4589	516.8025	426.0528	234.6688	96.0311	0.0000	0.0000	0.0000	0.0000	208.9620	422.7571	640.9099	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	705.4795	571.0525	470.7765	259.3026	106.1118	0.0000	0.0000	0.0000	0.0000	230.8972	467.1349	708.1877	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8901	89.9165	89.9411	89.9904	89.9018	87.3000	87.3000	87.3000	87.3000	89.5323	89.7639	89.8915	(217)
Fuel for water heating, kWh/month													
	161.3372	123.6320	96.7017	47.6497	23.6905	0.0000	0.0000	21.2950	48.7826	97.5988	135.7327	161.5003	(219)
Water heating fuel used												917.9206	(219)
Annual totals kWh/year													
Space heating fuel - main system												3518.9428	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3608.9656	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3518.9428	10.2300	359.9878	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	917.9206	10.2300	93.9033	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			252.8871	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3518.9428	0.2160	760.0916	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9206	0.2160	198.2709	(264)
Space and water heating			958.3625	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1368.9771		0.5190	-710.4991 (269)
Total kg/year				528.6836 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3518.9428	1.2200	4293.1102	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.9206	1.2200	1119.8632	(264)
Space and water heating			5412.9733	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2871.3272	(272)
Primary energy kWh/m2/year			30.0003	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	326.58 (P1)
Transmission heat loss coefficient	73.78 (37)
Summer heat loss coefficient	400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.3100	98.8453	0.4600	0.0000	0.9000	176.3736
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
North East	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						629.0720

	Jun	Jul	Aug	
Solar gains	671	629	548	(P4)
Internal gains	476	456	465	
Total summer gains	1146	1085	1013	(P5)
Summer gain/loss ratio	2.86	2.71	2.53	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.68	21.43	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-336	**Issued on Date**	05/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	20, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	9.45	**TER**	18.80
Environmental	93 A	**% DER<TER**	49.72		
CO_2 Emissions (t/year)	0.45	**DFEE**	46.51	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.89		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.45 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.84 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.51 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1940	(8)
Pressure test				Yes	
Measured/design AP50				4.8400	
Infiltration rate				0.4360	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5142	0.5041	0.4940	0.4436	0.4335	0.3831	0.3831	0.3730	0.4033	0.4335	0.4537	0.4738	(22b)
Effective ac	0.6322	0.6270	0.6220	0.5984	0.5940	0.5734	0.5734	0.5696	0.5813	0.5940	0.6029	0.6123	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0238	42.6744	42.3321	40.7238	40.4230	39.0223	39.0223	38.7629	39.5618	40.4230	41.0317	41.6680	(38)
Heat transfer coeff	98.9054	98.5561	98.2137	96.6055	96.3046	94.9039	94.9039	94.6445	95.4434	96.3046	96.9133	97.5497	(39)
Average = Sum(39)m / 12 =												96.6040	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2397	1.2353	1.2311	1.2109	1.2071	1.1896	1.1896	1.1863	1.1963	1.2071	1.2148	1.2227	(40)
HLP (average)												1.2109	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	479.6579	561.5879	644.2821	735.1563	801.3877	794.4072	755.2121	692.5931	621.1219	535.3775	472.1484	452.0581	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7969	33.9167	34.0349	34.6015	34.7096	35.2219	35.2219	35.3184	35.0228	34.7096	34.4916	34.2666	
alpha	3.2531	3.2611	3.2690	3.3068	3.3140	3.3481	3.3481	3.3546	3.3349	3.3140	3.2994	3.2844	
util living area													
	0.9872	0.9779	0.9576	0.9074	0.8089	0.6582	0.5161	0.5719	0.7913	0.9374	0.9793	0.9894	(86)
MIT	19.0265	19.2600	19.6450	20.1530	20.5821	20.8566	20.9528	20.9333	20.7170	20.1558	19.5084	18.9952	(87)
Th 2	19.8884	19.8918	19.8952	19.9113	19.9143	19.9284	19.9284	19.9310	19.9229	19.9143	19.9082	19.9019	(88)
util rest of house													
	0.9845	0.9731	0.9481	0.8857	0.7632	0.5772	0.4048	0.4599	0.7248	0.9183	0.9741	0.9871	(89)
MIT 2	17.2643	17.6050	18.1623	18.8913	19.4703	19.8112	19.9031	19.8920	19.6611	18.9113	17.9787	17.2270	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6283	17.9469	18.4686	19.1519	19.6999	20.0272	20.1199	20.1071	19.8792	19.1684	18.2947	17.5923	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4783	17.7969	18.3186	19.0019	19.5499	19.8772	19.9699	19.9571	19.7292	19.0184	18.1447	17.4423	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9599	0.9293	0.8628	0.7453	0.5730	0.4094	0.4629	0.7107	0.8969	0.9613	0.9791	(94)
Useful gains	467.7581	539.0513	598.7498	634.3097	597.2834	455.1888	309.1845	320.5783	441.4504	480.1993	453.8818	442.6106	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1303.4046	1271.0679	1160.7434	975.9023	755.9855	500.8237	319.8213	336.6602	537.2675	810.7271	1070.3769	1291.7778	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.7210	491.9151	418.1233	245.9467	118.0743	0.0000	0.0000	0.0000	0.0000	245.9127	443.8765	631.7804	(98)
Space heating												3217.3500	(98)
Space heating per m2											(98) / (4) =	40.3278	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3555.0828	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.7210	491.9151	418.1233	245.9467	118.0743	0.0000	0.0000	0.0000	0.0000	245.9127	443.8765	631.7804	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	686.9845	543.5526	462.0147	271.7643	130.4689	0.0000	0.0000	0.0000	0.0000	271.7267	490.4713	698.0999	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8090	89.7517	89.6309	89.3537	88.8065	87.3000	87.3000	87.3000	87.3000	89.3261	89.6767	89.8333	(217)
Fuel for water heating, kWh/month													
	183.9057	161.3800	167.7835	148.1963	144.1691	128.1956	120.4190	135.8687	136.8056	153.8614	165.4089	178.5379	(219)
Water heating fuel used												1824.5317	(219)
Annual totals kWh/year													
Space heating fuel - main system												3555.0828	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4592.9701	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3555.0828	0.2160	767.8979	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5317	0.2160	394.0988	(264)
Space and water heating			1161.9967	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			753.7283	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.4500	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.9463	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.9463	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	477.5869	547.6749	616.5471	691.3466	744.8356	735.2710	699.5666	646.9839	587.4835	517.1391	466.6654	452.2359	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9980	0.9957	0.9889	0.9637	0.8870	0.7269	0.5592	0.6206	0.8638	0.9786	0.9960	0.9985	(86)
MIT	19.7087	19.8601	20.1164	20.4641	20.7652	20.9407	20.9872	20.9790	20.8516	20.4640	20.0278	19.6869	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9973	0.9943	0.9849	0.9494	0.8433	0.6351	0.4355	0.4946	0.7952	0.9677	0.9943	0.9980	(89)
MIT 2	18.2122	18.4352	18.8096	19.3156	19.7192	19.9241	19.9593	19.9574	19.8374	19.3243	18.6903	18.1882	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9918	0.9803	0.9426	0.8424	0.6514	0.4611	0.5206	0.8020	0.9621	0.9920	0.9969	(94)
Useful gains	475.6656	543.1912	604.4008	651.6306	627.4780	478.9734	322.5858	336.8015	471.1769	497.5321	462.9126	450.8347	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1346.2718	1305.2056	1183.6873	988.2939	761.9733	505.6645	326.3480	343.5284	546.0281	829.0043	1103.9086	1337.5610	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating												3301.1128	(98)
Space heating per m2											(98) / (4) =	41.3777	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3534.3820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	693.5022	548.2588	461.4445	259.5263	107.1355	0.0000	0.0000	0.0000	0.0000	264.0421	494.1297	706.3430	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7754	87.5675	87.1161	86.0393	83.9305	80.3000	80.3000	80.3000	80.3000	85.9645	87.2817	87.8566	(217)
Fuel for water heating, kWh/month													
	230.1369	202.4498	211.7275	190.1418	188.7161	173.7253	166.4421	185.5439	187.5930	199.5363	209.7868	224.4996	(219)
Water heating fuel used												2370.2991	(219)
Annual totals kWh/year													
Space heating fuel - main system												3534.3820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6336.5938	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3534.3820	0.2160	763.4265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.2991	0.2160	511.9846	(264)
Space and water heating			1275.4111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1499.5738	(272)
Emissions per m2 for space and water heating			15.9866	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9866 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		4.8400	
Infiltration rate		0.3875	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4570	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6004	0.5964	0.5777	0.5742	0.5580	0.5580	0.5550	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1340	40.8580	40.5876	39.3172	39.0795	37.9731	37.9731	37.7682	38.3993	39.0795	39.5604	40.0630	(38)
Heat transfer coeff	97.0156	96.7397	96.4692	95.1989	94.9612	93.8547	93.8547	93.6498	94.2809	94.9612	95.4420	95.9447	(39)
Average = Sum(39)m / 12 =												95.1977	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2160	1.2126	1.2092	1.1933	1.1903	1.1764	1.1764	1.1739	1.1818	1.1903	1.1963	1.2026	(40)
HLP (average)												1.1933	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	447.5515	530.2595	614.5686	707.6361	775.2921	770.3155	732.8207	668.0200	595.7713	507.7574	441.9653	420.7243	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4552	34.5535	34.6504	35.1127	35.2006	35.6156	35.6156	35.6935	35.4546	35.2006	35.0233	34.8398	
alpha	3.2970	3.3036	3.3100	3.3408	3.3467	3.3744	3.3744	3.3796	3.3636	3.3467	3.3349	3.3227	
util living area													
	0.9895	0.9811	0.9621	0.9139	0.8173	0.6679	0.5249	0.5840	0.8035	0.9445	0.9828	0.9915	(86)
MIT	19.0158	19.2501	19.6365	20.1434	20.5767	20.8533	20.9518	20.9307	20.7078	20.1380	19.4884	18.9793	(87)
Th 2	19.9072	19.9099	19.9127	19.9254	19.9278	19.9389	19.9389	19.9410	19.9346	19.9278	19.9229	19.9179	(88)
util rest of house													
	0.9873	0.9769	0.9535	0.8935	0.7729	0.5876	0.4134	0.4718	0.7392	0.9272	0.9783	0.9896	(89)
MIT 2	18.0999	18.3343	18.7173	19.2178	19.6188	19.8565	19.9211	19.9130	19.7480	19.2237	18.5821	18.0715	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2891	18.5235	18.9072	19.4090	19.8167	20.0624	20.1340	20.1232	19.9463	19.4125	18.7693	18.2590	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2891	18.5235	18.9072	19.4090	19.8167	20.0624	20.1340	20.1232	19.9463	19.4125	18.7693	18.2590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9699	0.9432	0.8816	0.7677	0.5978	0.4350	0.4925	0.7400	0.9166	0.9718	0.9856	(94)
Useful gains	439.7476	514.2854	579.6761	623.8716	595.1788	460.4762	318.7684	329.0185	440.8675	465.4248	429.5146	414.6529	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1357.1635	1317.9314	1196.9140	1000.4434	770.7691	512.6687	331.6826	348.6775	551.1936	836.8485	1113.7437	1348.8859	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	682.5574	540.0501	459.2250	271.1316	130.6392	0.0000	0.0000	0.0000	0.0000	276.3392	492.6450	695.0694	(98)
Space heating												3547.6569	(98)
Space heating per m2											(98) / (4) =	44.4680	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	882.2345	694.5251	711.7388	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8145	0.8738	0.8431	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	718.5548	606.8442	600.0782	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	992.3023	946.6035	872.4862	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	197.0982	252.7809	202.6715	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												652.5506	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	49.2745	63.1952	50.6679	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												163.1377	(107)
Space cooling per m2												2.0448	(108)
Energy for space heating												44.4680	(99)
Energy for space cooling												2.0448	(108)
Total												46.5128	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	433.1016	504.2784	575.3879	653.0008	708.5389	701.6006	667.5895	612.2030	551.2975	478.0634	424.4085	408.5193	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9987	0.9970	0.9917	0.9707	0.9027	0.7505	0.5827	0.6495	0.8862	0.9844	0.9974	0.9991	(86)
MIT	19.6571	19.8103	20.0706	20.4261	20.7404	20.9314	20.9847	20.9744	20.8293	20.4223	19.9791	19.6360	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9983	0.9960	0.9886	0.9588	0.8626	0.6596	0.4554	0.5206	0.8236	0.9762	0.9962	0.9987	(89)
MIT 2	18.7060	18.8611	19.1221	19.4812	19.7733	19.9318	19.9601	19.9587	19.8607	19.4839	19.0407	18.6938	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9862	0.9549	0.8636	0.6763	0.4820	0.5474	0.8309	0.9732	0.9952	0.9983	(94)
Useful gains	432.0941	501.6546	567.4314	623.5564	611.8767	474.5116	321.7777	335.1368	458.0803	465.2667	422.3545	407.8088	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1382.3519	1336.1274	1206.1322	999.7594	765.4717	506.0479	326.3571	343.5322	547.3010	839.9201	1128.8358	1374.1031	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	706.9918	560.7658	475.1934	270.8661	114.2746	0.0000	0.0000	0.0000	0.0000	278.7422	508.6665	718.9230	(98)
Space heating												3634.4234	(98)
Space heating per m2											(98) / (4) =	45.5556	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8585	0.9202	0.8915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.3479	622.1787	617.6341	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	911.9861	870.3592	807.2455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	125.7395	184.6463	141.0709	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												451.4567	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	31.4349	46.1616	35.2677	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												112.8642 (107)
Space cooling per m2												1.4147 (108)
Energy for space heating												45.5556 (99)
Energy for space cooling												1.4147 (108)
Total												46.9703 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b)	= 101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c)	= 104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8400	
Infiltration rate			0.4360	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		= 0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		= 0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4234	0.3932	0.4033	0.3831	0.3831	0.3730	0.3629	0.3529	0.3428	0.3730	0.3529	0.3730	(22b)
Effective ac	0.5896	0.5773	0.5813	0.5734	0.5734	0.5696	0.5659	0.5623	0.5587	0.5696	0.5623	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1290	39.2886	39.5618	39.0223	39.0223	38.7629	38.5104	38.2648	38.0262	38.7629	38.2648	38.7629	(38)
Heat transfer coeff	96.0106	95.1702	95.4434	94.9039	94.9039	94.6445	94.3920	94.1465	93.9078	94.6445	94.1465	94.6445	(39)
Average = Sum(39)m / 12 =												94.7465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2034	1.1929	1.1963	1.1896	1.1896	1.1863	1.1832	1.1801	1.1771	1.1863	1.1801	1.1863	(40)
HLP (average)												1.1876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8159	35.1233	35.0228	35.2219	35.2219	35.3184	35.4129	35.5052	35.5955	35.3184	35.5052	35.3184	
alpha	3.3211	3.3416	3.3349	3.3481	3.3481	3.3546	3.3609	3.3670	3.3730	3.3546	3.3670	3.3546	
util living area													
	0.9615	0.9473	0.9095	0.8269	0.6950	0.5061	0.3781	0.4000	0.6379	0.8493	0.9371	0.9660	(86)
MIT	19.5005	19.6735	20.0263	20.4548	20.7742	20.9428	20.9838	20.9810	20.8746	20.5002	19.9701	19.4908	(87)
Th 2	19.9172	19.9257	19.9229	19.9284	19.9284	19.9310	19.9335	19.9360	19.9384	19.9310	19.9360	19.9310	(88)
util rest of house													
	0.9538	0.9370	0.8916	0.7928	0.6362	0.4226	0.2791	0.2963	0.5562	0.8107	0.9225	0.9591	(89)
MIT 2	17.9653	18.2175	18.7145	19.3037	19.7088	19.8913	19.9267	19.9278	19.8380	19.3813	18.6528	17.9610	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2824	18.5183	18.9855	19.5415	19.9289	20.1085	20.1451	20.1454	20.0521	19.6124	18.9249	18.2770	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1324	18.3683	18.8355	19.3915	19.7789	19.9585	19.9951	19.9954	19.9021	19.4624	18.7749	18.1270	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8689	0.7730	0.6272	0.4249	0.2850	0.3023	0.5532	0.7905	0.9016	0.9428	(94)
Useful gains	641.6861	689.2405	727.4202	719.9878	607.9537	424.6125	270.2880	269.0515	449.1920	571.8126	604.2151	610.7496	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1270.4508	1243.7086	1129.6162	938.7431	690.7961	440.9028	273.2702	272.5909	488.5186	763.0626	1023.8308	1242.3992	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.8010	372.6026	299.2338	157.5038	61.6348	0.0000	0.0000	0.0000	0.0000	142.2900	302.1233	469.9473	(98)
Space heating												2273.1365	(98)
RHI space heating demand												2273	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8400	
Infiltration rate			0.4360	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5142	0.5041	0.4940	0.4436	0.4335	0.3831	0.3831	0.3730	0.4033	0.4335	0.4537	0.4738	(22b)
Effective ac	0.6322	0.6270	0.6220	0.5984	0.5940	0.5734	0.5734	0.5696	0.5813	0.5940	0.6029	0.6123	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0238	42.6744	42.3321	40.7238	40.4230	39.0223	39.0223	38.7629	39.5618	40.4230	41.0317	41.6680	(38)
Heat transfer coeff	98.9054	98.5561	98.2137	96.6055	96.3046	94.9039	94.9039	94.6445	95.4434	96.3046	96.9133	97.5497	(39)
Average = Sum(39)m / 12 =												96.6040	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2397	1.2353	1.2311	1.2109	1.2071	1.1896	1.1896	1.1863	1.1963	1.2071	1.2148	1.2227	(40)
HLP (average)												1.2109	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745 (83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7969	33.9167	34.0349	34.6015	34.7096	35.2219	35.2219	35.3184	35.0228	34.7096	34.4916	34.2666	
alpha	3.2531	3.2611	3.2690	3.3068	3.3140	3.3481	3.3481	3.3546	3.3349	3.3140	3.2994	3.2844	
util living area													
	0.9691	0.9540	0.9242	0.8587	0.7460	0.5877	0.4492	0.4949	0.7089	0.8867	0.9533	0.9732	(86)
MIT	19.3035	19.5214	19.8720	20.3219	20.6815	20.8986	20.9689	20.9568	20.8027	20.3421	19.7556	19.2706	(87)
Th 2	19.8884	19.8918	19.8952	19.9113	19.9143	19.9284	19.9284	19.9310	19.9229	19.9143	19.9082	19.9019	(88)
util rest of house													
	0.9629	0.9449	0.9089	0.8298	0.6946	0.5082	0.3482	0.3918	0.6353	0.8571	0.9425	0.9678	(89)
MIT 2	17.6634	17.9779	18.4792	19.1144	19.5860	19.8485	19.9123	19.9069	19.7495	19.1588	18.3298	17.6246	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0022	18.2967	18.7669	19.3638	19.8123	20.0654	20.1306	20.1238	19.9670	19.4032	18.6243	17.9646	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8522	18.1467	18.6169	19.2138	19.6623	19.9154	19.9806	19.9738	19.8170	19.2532	18.4743	17.8146	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9256	0.8863	0.8078	0.6813	0.5072	0.3533	0.3961	0.6272	0.8347	0.9231	0.9531	(94)
Useful gains	624.3001	683.9961	721.2676	721.6855	645.7282	472.5965	313.9827	328.1162	479.6620	576.1785	589.7408	598.3714	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1340.3838	1305.5451	1190.0481	996.3717	766.8025	504.4530	320.8294	338.2384	545.6540	833.3468	1102.3240	1328.0996	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	532.7662	417.6809	348.7727	197.7740	90.0793	0.0000	0.0000	0.0000	0.0000	191.3333	369.0599	542.9178	(98)
Space heating												2690.3842	(98)
Space heating per m2											(98) / (4) =	33.7225	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2972.8002	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.7662	417.6809	348.7727	197.7740	90.0793	0.0000	0.0000	0.0000	0.0000	191.3333	369.0599	542.9178	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.6920	461.5259	385.3842	218.5349	99.5351	0.0000	0.0000	0.0000	0.0000	211.4180	407.8010	599.9092	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7217	89.6538	89.5115	89.1889	88.5938	87.3000	87.3000	87.3000	87.3000	89.1342	89.5588	89.7498	(217)
Fuel for water heating, kWh/month													
	184.0846	161.5561	168.0073	148.4702	144.5154	128.1956	120.4190	135.8687	136.8056	154.1927	165.6265	178.7041	(219)
Water heating fuel used												1826.4458	(219)
Annual totals kWh/year													
Space heating fuel - main system												2972.8002	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4012.6016	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2972.8002	3.4800	103.4534	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4458	3.4800	63.5603	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			183.2554	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6168	(257)
SAP value		91.3953	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2972.8002	0.2160	642.1248	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4458	0.2160	394.5123	(264)
Space and water heating			1036.6371	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			628.3687	(272)
CO2 emissions per m2			7.8800	(273)
EI value			93.2520	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8400	
Infiltration rate		0.4360	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4234	0.3932	0.4033	0.3831	0.3831	0.3730	0.3629	0.3529	0.3428	0.3730	0.3529	0.3730	(22b)
Effective ac	0.5896	0.5773	0.5813	0.5734	0.5734	0.5696	0.5659	0.5623	0.5587	0.5696	0.5623	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1290	39.2886	39.5618	39.0223	39.0223	38.7629	38.5104	38.2648	38.0262	38.7629	38.2648	38.7629	(38)
Heat transfer coeff	96.0106	95.1702	95.4434	94.9039	94.9039	94.6445	94.3920	94.1465	93.9078	94.6445	94.1465	94.6445	(39)
Average = Sum(39)m / 12 =												94.7465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2034	1.1929	1.1963	1.1896	1.1896	1.1863	1.1832	1.1801	1.1771	1.1863	1.1801	1.1863	(40)
HLP (average)												1.1876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8159	35.1233	35.0228	35.2219	35.2219	35.3184	35.4129	35.5052	35.5955	35.3184	35.5052	35.3184	
alpha	3.3211	3.3416	3.3349	3.3481	3.3481	3.3546	3.3609	3.3670	3.3730	3.3546	3.3670	3.3546	
util living area													
	0.9615	0.9473	0.9095	0.8269	0.6950	0.5061	0.3781	0.4000	0.6379	0.8493	0.9371	0.9660	(86)
MIT	19.5005	19.6735	20.0263	20.4548	20.7742	20.9428	20.9838	20.9810	20.8746	20.5002	19.9701	19.4908	(87)
Th 2	19.9172	19.9257	19.9229	19.9284	19.9284	19.9310	19.9335	19.9360	19.9384	19.9310	19.9360	19.9310	(88)
util rest of house													
	0.9538	0.9370	0.8916	0.7928	0.6362	0.4226	0.2791	0.2963	0.5562	0.8107	0.9225	0.9591	(89)
MIT 2	17.9653	18.2175	18.7145	19.3037	19.7088	19.8913	19.9267	19.9278	19.8380	19.3813	18.6528	17.9610	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2824	18.5183	18.9855	19.5415	19.9289	20.1085	20.1451	20.1454	20.0521	19.6124	18.9249	18.2770	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1324	18.3683	18.8355	19.3915	19.7789	19.9585	19.9951	19.9954	19.9021	19.4624	18.7749	18.1270	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8689	0.7730	0.6272	0.4249	0.2850	0.3023	0.5532	0.7905	0.9016	0.9428	(94)
Useful gains	641.6861	689.2405	727.4202	719.9878	607.9537	424.6125	270.2880	269.0515	449.1920	571.8126	604.2151	610.7496	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1270.4508	1243.7086	1129.6162	938.7431	690.7961	440.9028	273.2702	272.5909	488.5186	763.0626	1023.8308	1242.3992	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.8010	372.6026	299.2338	157.5038	61.6348	0.0000	0.0000	0.0000	0.0000	142.2900	302.1233	469.9473	(98)
Space heating												2273.1365	(98)
Space heating per m2											(98) / (4) =	28.4926	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2511.7531	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	467.8010	372.6026	299.2338	157.5038	61.6348	0.0000	0.0000	0.0000	0.0000	142.2900	302.1233	469.9473	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	516.9071	411.7156	330.6451	174.0374	68.1048	0.0000	0.0000	0.0000	0.0000	157.2265	333.8379	519.2788	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6426	89.5809	89.4039	89.0098	88.3148	87.3000	87.3000	87.3000	87.3000	88.8990	89.4207	89.6637	(217)
Fuel for water heating, kWh/month													
	184.2471	161.6877	168.2095	148.7689	144.9719	128.1956	120.4190	135.8687	136.8056	154.6007	165.8825	178.8756	(219)
Water heating fuel used												1828.5328	(219)
Annual totals kWh/year													
Space heating fuel - main system												2511.7531	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3403.2214	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2511.7531	10.2300	256.9523	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.5328	10.2300	187.0589	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			202.9212	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2511.7531	0.2160	542.5387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5328	0.2160	394.9631	(264)
Space and water heating			937.5018	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			451.1653	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2511.7531	1.2200	3064.3388	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5328	1.2200	2230.8100	(264)
Space and water heating			5295.1488	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2418.3608	(272)
Primary energy kWh/m2/year			30.3129	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (41.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£547	£447	£100
Space heating	£387	£387	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£203	£121	£82
Total cost of uses	£202	£121	£81
Delivered energy	43 kWh/m²	31 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	30 kWh/m²	17 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8400	
Infiltration rate			0.4360	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5142	0.5041	0.4940	0.4436	0.4335	0.3831	0.3831	0.3730	0.4033	0.4335	0.4537	0.4738	(22b)
Effective ac	0.6322	0.6270	0.6220	0.5984	0.5940	0.5734	0.5734	0.5696	0.5813	0.5940	0.6029	0.6123	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0238	42.6744	42.3321	40.7238	40.4230	39.0223	39.0223	38.7629	39.5618	40.4230	41.0317	41.6680	(38)
Heat transfer coeff	98.9054	98.5561	98.2137	96.6055	96.3046	94.9039	94.9039	94.6445	95.4434	96.3046	96.9133	97.5497	(39)
Average = Sum(39)m / 12 =												96.6040	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2397	1.2353	1.2311	1.2109	1.2071	1.1896	1.1896	1.1863	1.1963	1.2071	1.2148	1.2227	(40)
HLP (average)												1.2109	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7969	33.9167	34.0349	34.6015	34.7096	35.2219	35.2219	35.3184	35.0228	34.7096	34.4916	34.2666	
alpha	3.2531	3.2611	3.2690	3.3068	3.3140	3.3481	3.3481	3.3546	3.3349	3.3140	3.2994	3.2844	
util living area													
	0.9691	0.9540	0.9242	0.8587	0.7460	0.5877	0.4492	0.4949	0.7089	0.8867	0.9533	0.9732	(86)
MIT	19.3035	19.5214	19.8720	20.3219	20.6815	20.8986	20.9689	20.9568	20.8027	20.3421	19.7556	19.2706	(87)
Th 2	19.8884	19.8918	19.8952	19.9113	19.9143	19.9284	19.9284	19.9310	19.9229	19.9143	19.9082	19.9019	(88)
util rest of house													
	0.9629	0.9449	0.9089	0.8298	0.6946	0.5082	0.3482	0.3918	0.6353	0.8571	0.9425	0.9678	(89)
MIT 2	17.6634	17.9779	18.4792	19.1144	19.5860	19.8485	19.9123	19.9069	19.7495	19.1588	18.3298	17.6246	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0022	18.2967	18.7669	19.3638	19.8123	20.0654	20.1306	20.1238	19.9670	19.4032	18.6243	17.9646	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8522	18.1467	18.6169	19.2138	19.6623	19.9154	19.9806	19.9738	19.8170	19.2532	18.4743	17.8146	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9256	0.8863	0.8078	0.6813	0.5072	0.3533	0.3961	0.6272	0.8347	0.9231	0.9531	(94)
Useful gains	624.3001	683.9961	721.2676	721.6855	645.7282	472.5965	313.9827	328.1162	479.6620	576.1785	589.7408	598.3714	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1340.3838	1305.5451	1190.0481	996.3717	766.8025	504.4530	320.8294	338.2384	545.6540	833.3468	1102.3240	1328.0996	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	532.7662	417.6809	348.7727	197.7740	90.0793	0.0000	0.0000	0.0000	0.0000	191.3333	369.0599	542.9178	(98)
Space heating												2690.3842	(98)
Space heating per m2											(98) / (4) =	33.7225	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2972.8002	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.7662	417.6809	348.7727	197.7740	90.0793	0.0000	0.0000	0.0000	0.0000	191.3333	369.0599	542.9178	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.6920	461.5259	385.3842	218.5349	99.5351	0.0000	0.0000	0.0000	0.0000	211.4180	407.8010	599.9092	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8122	89.8433	89.8798	89.9538	90.0850	87.3000	87.3000	87.3000	87.3000	89.4888	89.6967	89.8253	(217)
Fuel for water heating, kWh/month													
	156.6682	115.7903	89.9862	43.6521	14.3752	0.0000	0.0000	24.1300	49.2919	95.2818	133.0305	155.7694	(219)
Water heating fuel used												877.9756	(219)
Annual totals kWh/year													
Space heating fuel - main system												2972.8002	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3114.1313	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2972.8002	3.4800	103.4534	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9756	3.4800	30.5535	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			156.8436	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5279	(257)
SAP value	92.6355	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2972.8002	0.2160	642.1248	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9756	0.2160	189.6427	(264)
Space and water heating			831.7676	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			449.4491	(272)
CO2 emissions per m2			5.6300	(273)
EI value			95.1734	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8400	
Infiltration rate			0.4360	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4033	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4234	0.3932	0.4033	0.3831	0.3831	0.3730	0.3629	0.3529	0.3428	0.3730	0.3529	0.3730	(22b)
Effective ac	0.5896	0.5773	0.5813	0.5734	0.5734	0.5696	0.5659	0.5623	0.5587	0.5696	0.5623	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1290	39.2886	39.5618	39.0223	39.0223	38.7629	38.5104	38.2648	38.0262	38.7629	38.2648	38.7629	(38)
Heat transfer coeff	96.0106	95.1702	95.4434	94.9039	94.9039	94.6445	94.3920	94.1465	93.9078	94.6445	94.1465	94.6445	(39)
Average = Sum(39)m / 12 =												94.7465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2034	1.1929	1.1963	1.1896	1.1896	1.1863	1.1832	1.1801	1.1771	1.1863	1.1801	1.1863	(40)
HLP (average)												1.1876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3932 (H8)
Utilisation factor	0.5122 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-875.5295 (H17)

Solar input (sum of months) = Sum(63)m = -875.5295 (63)

Solar input	-28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862 (63)

Output from w/h

	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003 (64)

Total per year (kWh/year) = Sum(64)m = 763.3548 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723 (83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8159	35.1233	35.0228	35.2219	35.2219	35.3184	35.4129	35.5052	35.5955	35.3184	35.5052	35.3184	
alpha	3.3211	3.3416	3.3349	3.3481	3.3481	3.3546	3.3609	3.3670	3.3730	3.3546	3.3670	3.3546	
util living area	0.9615	0.9473	0.9095	0.8269	0.6950	0.5061	0.3781	0.4000	0.6379	0.8493	0.9371	0.9660	(86)
MIT	19.5005	19.6735	20.0263	20.4548	20.7742	20.9428	20.9838	20.9810	20.8746	20.5002	19.9701	19.4908	(87)
Th 2	19.9172	19.9257	19.9229	19.9284	19.9284	19.9310	19.9335	19.9360	19.9384	19.9310	19.9360	19.9310	(88)
util rest of house	0.9538	0.9370	0.8916	0.7928	0.6362	0.4226	0.2791	0.2963	0.5562	0.8107	0.9225	0.9591	(89)
MIT 2	17.9653	18.2175	18.7145	19.3037	19.7088	19.8913	19.9267	19.9278	19.8380	19.3813	18.6528	17.9610	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2824	18.5183	18.9855	19.5415	19.9289	20.1085	20.1451	20.1454	20.0521	19.6124	18.9249	18.2770	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1324	18.3683	18.8355	19.3915	19.7789	19.9585	19.9951	19.9954	19.9021	19.4624	18.7749	18.1270	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8689	0.7730	0.6272	0.4249	0.2850	0.3023	0.5532	0.7905	0.9016	0.9428	(94)
Useful gains	641.6861	689.2405	727.4202	719.9878	607.9537	424.6125	270.2880	269.0515	449.1920	571.8126	604.2151	610.7496	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1270.4508	1243.7086	1129.6162	938.7431	690.7961	440.9028	273.2702	272.5909	488.5186	763.0626	1023.8308	1242.3992	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.8010	372.6026	299.2338	157.5038	61.6348	0.0000	0.0000	0.0000	0.0000	142.2900	302.1233	469.9473	(98)
Space heating												2273.1365	(98)
Space heating per m2											(98) / (4) =	28.4926	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2511.7531	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	467.8010	372.6026	299.2338	157.5038	61.6348	0.0000	0.0000	0.0000	0.0000	142.2900	302.1233	469.9473	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	516.9071	411.7156	330.6451	174.0374	68.1048	0.0000	0.0000	0.0000	0.0000	157.2265	333.8379	519.2788	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7564	89.7807	89.8016	89.8566	89.7752	87.3000	87.3000	87.3000	87.3000	89.3088	89.5971	89.7578	(217)
Fuel for water heating, kWh/month													
	152.1919	116.0919	89.7328	42.5531	19.3917	0.0000	0.0000	17.2721	43.9527	91.1399	127.8524	152.5219	(219)
Water heating fuel used												852.7004	(219)
Annual totals kWh/year													
Space heating fuel - main system												2511.7531	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2477.3890	(238)

10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2511.7531	10.2300	256.9523	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.7004	10.2300	87.2313	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			121.4535	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2511.7531	0.2160	542.5387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7004	0.2160	184.1833	(264)
Space and water heating			726.7220	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			266.3355	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2511.7531	1.2200	3064.3388	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7004	1.2200	1040.2945	(264)
Space and water heating			4104.6333	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1381.3453	(272)
Primary energy kWh/m2/year			17.3144	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North East	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						594.2884

	Jun	Jul	Aug	
Solar gains	633	594	519	(P4)
Internal gains	428	410	418	
Total summer gains	1061	1004	938	(P5)
Summer gain/loss ratio	3.23	3.06	2.86	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.18	21.91	21.60	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-337	**Issued on Date**	18/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	19, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	9.52	**TER**	18.99
Environmental	93 A	**% DER<TER**	49.88		
CO_2 Emissions (t/year)	0.46	**DFEE**	47.31	**TFEE**	55.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.66		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.99 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.52 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.3 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.62 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 7.51 m², No overhang
Windows facing South West: 5.06 m², No overhang
Windows facing North West: 2.16 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1940	(8)
Pressure test				Yes	
Measured/design AP50				4.6200	
Infiltration rate				0.4250	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095	(36)
Total fabric heat loss	(33) + (36) =	57.6202	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	100.1957	99.8638	99.5385	98.0104	97.7245	96.3936	96.3936	96.1472	96.9063	97.7245	98.3029	98.9075	(39)
Average = Sum(39)m / 12 =												98.0090	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2559	1.2517	1.2477	1.2285	1.2249	1.2082	1.2082	1.2052	1.2147	1.2249	1.2322	1.2398	(40)
HLP (average)												1.2285	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	373.9690	371.8757	358.4017	336.6737	314.6131	293.3542	279.5453	285.5173	296.6803	318.6197	343.8235	362.7252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	478.5582	562.8662	653.8190	759.8600	840.7808	838.6619	795.7314	721.3669	635.7911	538.8980	471.4349	450.7191	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1528	33.2630	33.3717	33.8920	33.9912	34.4605	34.4605	34.5488	34.2782	33.9912	33.7912	33.5846	
alpha	3.2102	3.2175	3.2248	3.2595	3.2661	3.2974	3.2974	3.3033	3.2852	3.2661	3.2527	3.2390	
util living area													
	0.9871	0.9775	0.9559	0.9009	0.7945	0.6392	0.4995	0.5594	0.7856	0.9366	0.9792	0.9893	(86)
MIT	18.9883	19.2265	19.6262	20.1542	20.5932	20.8628	20.9548	20.9343	20.7135	20.1361	19.4750	18.9549	(87)
Th 2	19.8755	19.8788	19.8821	19.8973	19.9001	19.9134	19.9134	19.9159	19.9083	19.9001	19.8943	19.8883	(88)
util rest of house													
	0.9843	0.9727	0.9460	0.8781	0.7469	0.5576	0.3893	0.4474	0.7180	0.9173	0.9739	0.9870	(89)
MIT 2	17.2023	17.5495	18.1277	18.8826	19.4713	19.8027	19.8895	19.8779	19.6445	18.8748	17.9229	17.1613	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.5712	17.8959	18.4373	19.1453	19.7030	20.0217	20.1096	20.0961	19.8653	19.1353	18.2435	17.5318	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4212	17.7459	18.2873	18.9953	19.5530	19.8717	19.9596	19.9461	19.7153	18.9853	18.0935	17.3818	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9591	0.9266	0.8547	0.7295	0.5541	0.3943	0.4508	0.7039	0.8954	0.9609	0.9788	(94)
Useful gains	466.5167	539.8473	605.8395	649.4185	613.3753	464.7320	313.7207	325.1979	447.5193	482.5305	453.0032	441.1606	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1314.6909	1282.8440	1173.2864	989.4414	767.4336	508.1554	323.8415	340.9491	544.1571	819.4529	1080.6919	1303.7766	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	631.0416	499.2938	422.1805	244.8165	114.6194	0.0000	0.0000	0.0000	0.0000	250.6703	451.9359	641.7863	(98)
Space heating												3256.3443	(98)
Space heating per m2											(98) / (4) =	40.8165	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3598.1705	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	631.0416	499.2938	422.1805	244.8165	114.6194	0.0000	0.0000	0.0000	0.0000	250.6703	451.9359	641.7863	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	697.2836	551.7059	466.4978	270.5155	126.6513	0.0000	0.0000	0.0000	0.0000	276.9838	499.3766	709.1561	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8171	89.7602	89.6370	89.3503	88.7829	87.3000	87.3000	87.3000	87.3000	89.3403	89.6876	89.8416	(217)
Fuel for water heating, kWh/month													
	183.8892	161.3647	167.7720	148.2020	144.2076	128.1956	120.4190	135.8687	136.8056	153.8370	165.3887	178.5215	(219)
Water heating fuel used												1824.4715	(219)
Annual totals kWh/year													
Space heating fuel - main system												3598.1705	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4629.8401	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3598.1705	0.2160	777.2048	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.4715	0.2160	394.0858	(264)
Space and water heating			1171.2907	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			759.8265	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.5200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.5200	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		28.0163	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.0163	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.7300	1.3258	19.5284			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.1800	13.5864			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.6162			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.6159	(36)
Total fabric heat loss (33) + (36) =	55.2321	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	96.6625	96.3751	96.0934	94.7700	94.5224	93.3698	93.3698	93.1564	93.8138	94.5224	95.0233	95.5469	(39)
Average = Sum(39)m / 12 =												94.7688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2116	1.2080	1.2045	1.1879	1.1848	1.1703	1.1703	1.1677	1.1759	1.1848	1.1911	1.1976	(40)
HLP (average)												1.1879	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.3480	383.9438	369.8475	347.4993	324.8144	302.9329	289.1310	295.7251	307.5157	330.0754	355.8972	375.1080	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(81)

Solar gains	90.2423	164.7916	254.8938	365.1362	453.9912	470.5058	445.3789	376.0624	292.5936	190.0619	110.1064	75.9234	(83)
Total gains	476.5902	548.7354	624.7413	712.6355	778.8055	773.4386	734.5099	671.7875	600.1093	520.1372	466.0036	451.0315	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.3157	57.4866	57.6552	58.4603	58.6134	59.3369	59.3369	59.4729	59.0561	58.6134	58.3044	57.9849	
alpha	4.8210	4.8324	4.8437	4.8974	4.9076	4.9558	4.9558	4.9649	4.9371	4.9076	4.8870	4.8657	
util living area													
	0.9980	0.9957	0.9886	0.9608	0.8768	0.7103	0.5450	0.6113	0.8614	0.9788	0.9960	0.9985	(86)
MIT	19.6745	19.8290	20.0958	20.4598	20.7705	20.9435	20.9877	20.9790	20.8473	20.4456	19.9990	19.6522	(87)
Th 2	19.9107	19.9136	19.9164	19.9297	19.9322	19.9438	19.9438	19.9460	19.9393	19.9322	19.9272	19.9219	(88)
util rest of house													
	0.9974	0.9943	0.9843	0.9456	0.8304	0.6170	0.4215	0.4842	0.7915	0.9679	0.9944	0.9980	(89)
MIT 2	18.1483	18.3758	18.7653	19.2937	19.7070	19.9064	19.9393	19.9373	19.8144	19.2834	18.6342	18.1236	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.4636	18.6760	19.0401	19.5346	19.9267	20.1206	20.1559	20.1525	20.0277	19.5235	18.9161	18.4394	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4636	18.6760	19.0401	19.5346	19.9267	20.1206	20.1559	20.1525	20.0277	19.5235	18.9161	18.4394	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9917	0.9796	0.9384	0.8301	0.6338	0.4471	0.5104	0.7984	0.9621	0.9920	0.9969	(94)
Useful gains	474.6679	544.2067	611.9795	668.7146	646.4743	490.1918	328.4249	342.8889	479.1289	500.4097	462.2748	449.6290	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1369.0886	1327.6591	1205.0230	1007.8366	777.6058	515.4597	332.0124	349.5700	556.1039	843.4682	1122.8080	1360.5268	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	665.4490	526.4800	441.2244	244.1678	97.5619	0.0000	0.0000	0.0000	0.0000	255.2355	475.5839	677.7079	(98)
Space heating												3383.4104	(98)
Space heating per m2											(98) / (4) =	42.4093	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3622.4951	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	665.4490	526.4800	441.2244	244.1678	97.5619	0.0000	0.0000	0.0000	0.0000	255.2355	475.5839	677.7079	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	712.4722	563.6831	472.4030	261.4217	104.4560	0.0000	0.0000	0.0000	0.0000	273.2714	509.1905	725.5974	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8275	87.6237	87.1679	86.0573	83.8718	80.3000	80.3000	80.3000	80.3000	86.0498	87.3460	87.9075	(217)
Fuel for water heating, kWh/month													
	230.0005	202.3199	211.6016	190.1020	188.8482	173.7253	166.4421	185.5439	187.5930	199.3386	209.6323	224.3697	(219)
Water heating fuel used												2369.5171	(219)
Annual totals kWh/year													
Space heating fuel - main system												3622.4951	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Total delivered energy for all uses												6417.7674	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3622.4951	0.2160	782.4589	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2369.5171	0.2160	511.8157	(264)
Space and water heating			1294.2746	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Total CO2, kg/m2/year			1515.2416	(272)
Emissions per m2 for space and water heating			16.2230	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2818	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2230 * 1.00) + 2.2818 + 0.4879, rounded to 2 d.p.			18.9900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		4.6200	
Infiltration rate		0.3765	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3482	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4440	0.4353	0.4266	0.3831	0.3744	0.3308	0.3308	0.3221	0.3482	0.3744	0.3918	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7362	40.4758	40.2204	39.0212	38.7968	37.7523	37.7523	37.5589	38.1546	38.7968	39.2507	39.7253	(38)
Heat transfer coeff	98.3564	98.0960	97.8406	96.6414	96.4170	95.3725	95.3725	95.1791	95.7748	96.4170	96.8709	97.3455	(39)
Average = Sum(39)m / 12 =												96.6403	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2328	1.2296	1.2264	1.2113	1.2085	1.1954	1.1954	1.1930	1.2005	1.2085	1.2142	1.2202	(40)
HLP (average)												1.2113	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	341.8626	340.5473	328.6882	309.1535	288.5176	269.2625	257.1539	260.9442	271.3298	290.9996	313.6403	331.3914	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	446.4518	531.5378	624.1056	732.3398	814.6852	814.5702	773.3401	696.7938	610.4405	511.2779	441.2517	419.3853	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7728	33.8625	33.9509	34.3722	34.4522	34.8295	34.8295	34.9003	34.6832	34.4522	34.2907	34.1236	
alpha	3.2515	3.2575	3.2634	3.2915	3.2968	3.3220	3.3220	3.3267	3.3122	3.2968	3.2860	3.2749	
util living area													
	0.9894	0.9807	0.9604	0.9075	0.8026	0.6483	0.5076	0.5709	0.7976	0.9437	0.9827	0.9913	(86)
MIT	18.9763	19.2154	19.6170	20.1445	20.5882	20.8599	20.9538	20.9318	20.7043	20.1177	19.4540	18.9378	(87)
Th 2	19.8938	19.8964	19.8990	19.9109	19.9132	19.9236	19.9236	19.9256	19.9196	19.9132	19.9086	19.9039	(88)
util rest of house													
	0.9871	0.9765	0.9515	0.8859	0.7563	0.5672	0.3971	0.4586	0.7320	0.9262	0.9782	0.9895	(89)
MIT 2	18.0518	18.2906	18.6883	19.2071	19.6151	19.8459	19.9068	19.8984	19.7318	19.1934	18.5384	18.0208	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2428	18.4817	18.8802	19.4007	19.8161	20.0553	20.1231	20.1118	19.9327	19.3843	18.7275	18.2102	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2428	18.4817	18.8802	19.4007	19.8161	20.0553	20.1231	20.1118	19.9327	19.3843	18.7275	18.2102	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9693	0.9408	0.8737	0.7516	0.5779	0.4186	0.4795	0.7329	0.9153	0.9715	0.9853	(94)
Useful gains	438.5505	515.1983	587.1687	639.8746	612.3086	470.7547	323.7576	334.0904	447.4208	467.9500	428.6837	413.2390	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1371.3597	1332.3070	1211.2835	1014.8034	782.5296	520.2894	336.0086	353.2903	558.6246	846.9570	1126.3677	1363.8291	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.0101	549.0970	464.3414	269.9488	126.6444	0.0000	0.0000	0.0000	0.0000	281.9812	502.3324	707.2391	(98)
Space heating												3595.5944	(98)
Space heating per m2											(98) / (4) =	45.0689	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	896.5015	705.7565	723.3609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8233	0.8796	0.8468	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	738.1195	620.7786	612.5575	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1043.8684	993.7907	905.8929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	220.1392	277.5210	218.2415	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												715.9018	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.0348	69.3803	54.5604	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												178.9754	(107)
Space cooling per m2												2.2434	(108)
Energy for space heating												45.0689	(99)
Energy for space cooling												2.2434	(108)
Total												47.3122	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.7300	1.3258	19.5284			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.1800	13.5864			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.6162			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.6159	(36)
Total fabric heat loss (33) + (36) =	55.2321	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	96.6625	96.3751	96.0934	94.7700	94.5224	93.3698	93.3698	93.1564	93.8138	94.5224	95.0233	95.5469	(39)
Average = Sum(39)m / 12 =												94.7688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2116	1.2080	1.2045	1.1879	1.1848	1.1703	1.1703	1.1677	1.1759	1.1848	1.1911	1.1976	(40)
HLP (average)												1.1879	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	341.8626	340.5473	328.6882	309.1535	288.5176	269.2625	257.1539	260.9442	271.3298	290.9996	313.6403	331.3914	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(81)

Solar gains	90.2423	164.7916	254.8938	365.1362	453.9912	470.5058	445.3789	376.0624	292.5936	190.0619	110.1064	75.9234	(83)
Total gains	432.1049	505.3389	583.5820	674.2897	742.5087	739.7682	702.5328	637.0066	563.9234	481.0615	423.7467	407.3148	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.3157	57.4866	57.6552	58.4603	58.6134	59.3369	59.3369	59.4729	59.0561	58.6134	58.3044	57.9849	
alpha	4.8210	4.8324	4.8437	4.8974	4.9076	4.9558	4.9558	4.9649	4.9371	4.9076	4.8870	4.8657	
util living area													
	0.9987	0.9970	0.9914	0.9680	0.8925	0.7329	0.5671	0.6388	0.8834	0.9845	0.9974	0.9991	(86)
MIT	19.6232	19.7794	20.0502	20.4225	20.7469	20.9350	20.9854	20.9746	20.8252	20.4041	19.9505	19.6016	(87)
Th 2	19.9107	19.9136	19.9164	19.9297	19.9322	19.9438	19.9438	19.9460	19.9393	19.9322	19.9272	19.9219	(88)
util rest of house													
	0.9983	0.9960	0.9881	0.9551	0.8496	0.6400	0.4399	0.5088	0.8193	0.9761	0.9963	0.9987	(89)
MIT 2	18.6562	18.8144	19.0858	19.4606	19.7599	19.9139	19.9401	19.9386	19.8388	19.4496	18.9962	18.6435	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8560	19.0137	19.2850	19.6593	19.9638	20.1248	20.1560	20.1526	20.0426	19.6468	19.1934	18.8414	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8560	19.0137	19.2850	19.6593	19.9638	20.1248	20.1560	20.1526	20.0426	19.6468	19.1934	18.8414	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9947	0.9856	0.9510	0.8511	0.6573	0.4665	0.5358	0.8268	0.9731	0.9952	0.9982	(94)
Useful gains	431.0935	502.6771	575.1494	641.2739	631.9205	486.2344	327.7087	341.3339	466.2316	468.1245	421.6995	406.6013	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1407.0185	1360.2111	1228.5567	1019.6583	781.1106	515.8503	332.0264	349.5830	557.4945	855.1243	1149.1503	1398.9424	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	726.0882	576.2628	486.1350	272.4367	110.9974	0.0000	0.0000	0.0000	0.0000	287.9278	523.7646	738.3018	(98)
Space heating												3721.9144	(98)
Space heating per m2											(98) / (4) =	46.6522	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	877.6761	690.9365	707.9883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8657	0.9240	0.8933	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	759.8295	638.4217	632.4644	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	956.4375	911.0290	836.0118	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	141.5577	202.8198	151.4392	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												495.8168	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	35.3894	50.7050	37.8598	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												123.9542 (107)
Space cooling per m2												1.5537 (108)
Energy for space heating												46.6522 (99)
Energy for space cooling												1.5537 (108)
Total												48.2059 (109)
Target Fabric Energy Efficiency (TFEE)												55.4 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	97.4452	96.6467	96.9063	96.3936	96.3936	96.1472	95.9073	95.6739	95.4472	96.1472	95.6739	96.1472	(39)
Average = Sum(39)m / 12 =												96.2441	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2214	1.2114	1.2147	1.2082	1.2082	1.2052	1.2021	1.1992	1.1964	1.2052	1.1992	1.2052	(40)
HLP (average)												1.2064	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northwest	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(81)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.0372	204.6716	321.4656	465.9871	551.6305	620.9856	583.2645	504.2878	390.7974	255.3873	159.5800	108.2337	(83)
Total gains	684.1579	753.4873	849.0455	960.6070	1012.4971	1051.5729	996.1120	925.3192	830.7536	728.5150	669.6041	646.1798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0886	34.3703	34.2782	34.4605	34.4605	34.5488	34.6353	34.7197	34.8022	34.5488	34.7197	34.5488	
alpha	3.2726	3.2914	3.2852	3.2974	3.2974	3.3033	3.3090	3.3146	3.3201	3.3033	3.3146	3.3033	
util living area	0.9616	0.9471	0.9073	0.8190	0.6806	0.4903	0.3662	0.3911	0.6330	0.8490	0.9375	0.9661	(86)
MIT	19.4602	19.6379	20.0072	20.4541	20.7791	20.9449	20.9842	20.9810	20.8716	20.4832	19.9365	19.4484	(87)
Th 2	19.9029	19.9109	19.9083	19.9134	19.9134	19.9159	19.9183	19.9206	19.9229	19.9159	19.9206	19.9159	(88)
util rest of house	0.9539	0.9367	0.8890	0.7839	0.6210	0.4076	0.2687	0.2881	0.5506	0.8103	0.9230	0.9592	(89)
MIT 2	17.8992	18.1578	18.6779	19.2904	19.7001	19.8781	19.9117	19.9126	19.8205	19.3478	18.5958	17.8914	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2217	18.4635	18.9525	19.5308	19.9230	20.0984	20.1333	20.1333	20.0376	19.5824	18.8728	18.2130	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0717	18.3135	18.8025	19.3808	19.7730	19.9484	19.9833	19.9833	19.8876	19.4324	18.7228	18.0630	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9361	0.9165	0.8657	0.7640	0.6126	0.4102	0.2747	0.2943	0.5476	0.7895	0.9017	0.9427	(94)
Useful gains	640.4245	690.5583	735.0429	733.9182	620.2429	431.3203	273.6386	272.3293	454.9597	575.1564	603.7886	609.1319	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1283.5150	1257.7142	1143.7325	952.4450	701.0743	446.9335	276.5262	275.8536	495.1411	772.2888	1035.4554	1255.9706	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	478.4594	381.1288	304.0650	157.3393	60.1385	0.0000	0.0000	0.0000	0.0000	146.6665	310.8001	481.2480	(98)

Space heating 2319.8456 (98)
RHI space heating demand 2320 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	100.1957	99.8638	99.5385	98.0104	97.7245	96.3936	96.3936	96.1472	96.9063	97.7245	98.3029	98.9075	(39)
Average = Sum(39)m / 12 =												98.0090	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2559	1.2517	1.2477	1.2285	1.2249	1.2082	1.2082	1.2052	1.2147	1.2249	1.2322	1.2398	(40)
HLP (average)												1.2285	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	657.7100	739.8062	822.9972	917.8062	987.0343	975.8951	929.0338	856.8810	779.0670	693.4059	637.6355	625.9400	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1528	33.2630	33.3717	33.8920	33.9912	34.4605	34.4605	34.5488	34.2782	33.9912	33.7912	33.5846	
alpha	3.2102	3.2175	3.2248	3.2595	3.2661	3.2974	3.2974	3.3033	3.2852	3.2661	3.2527	3.2390	
util living area													
	0.9691	0.9538	0.9226	0.8524	0.7331	0.5726	0.4372	0.4863	0.7051	0.8867	0.9535	0.9732	(86)
MIT	19.2647	19.4871	19.8517	20.3191	20.6871	20.9014	20.9695	20.9566	20.7979	20.3220	19.7216	19.2295	(87)
Th 2	19.8755	19.8788	19.8821	19.8973	19.9001	19.9134	19.9134	19.9159	19.9083	19.9001	19.8943	19.8883	(88)
util rest of house													
	0.9629	0.9447	0.9069	0.8226	0.6806	0.4931	0.3370	0.3832	0.6308	0.8569	0.9427	0.9678	(89)
MIT 2	17.6004	17.9214	18.4422	19.0995	19.5796	19.8364	19.8979	19.8919	19.7311	19.1219	18.2734	17.5578	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9442	18.2448	18.7333	19.3514	19.8084	20.0564	20.1192	20.1118	19.9515	19.3698	18.5725	17.9031	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7942	18.0948	18.5833	19.2014	19.6584	19.9064	19.9692	19.9618	19.8015	19.2198	18.4225	17.7531	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9250	0.8837	0.8003	0.6677	0.4925	0.3424	0.3878	0.6226	0.8339	0.9230	0.9529	(94)
Useful gains	622.6050	684.2976	727.2848	734.5427	659.0826	480.6618	318.0962	332.3251	485.0856	578.2641	588.5644	596.4534	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1352.0630	1317.6854	1202.7552	1009.6482	777.7284	511.5059	324.7711	342.4584	552.5101	842.3624	1113.0364	1340.5023	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	542.7168	425.6365	353.7500	198.0759	88.2725	0.0000	0.0000	0.0000	0.0000	196.4891	377.6198	553.5724	(98)
Space heating												2736.1330	(98)
Space heating per m2											(98) / (4) =	34.2960	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3023.3514	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.7168	425.6365	353.7500	198.0759	88.2725	0.0000	0.0000	0.0000	0.0000	196.4891	377.6198	553.5724	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.6871	470.3166	390.8840	218.8684	97.5386	0.0000	0.0000	0.0000	0.0000	217.1150	417.2595	611.6822	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7326	89.6655	89.5211	89.1901	88.5782	87.3000	87.3000	87.3000	87.3000	89.1550	89.5740	89.7609	(217)
Fuel for water heating, kWh/month													
	184.0624	161.5350	167.9892	148.4682	144.5408	128.1956	120.4190	135.8687	136.8056	154.1568	165.5985	178.6819	(219)
Water heating fuel used												1826.3218	(219)
Annual totals kWh/year													
Space heating fuel - main system												3023.3514	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4056.8713	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3023.3514	3.4800	105.2126	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.3218	3.4800	63.5560	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	350.7552	13.1900	46.2646	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			184.1981	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6200	(257)
SAP value		91.3510	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3023.3514	0.2160	653.0439	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.3218	0.2160	394.4855	(264)
Space and water heating			1047.5294	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			636.0652	(272)
CO2 emissions per m2			7.9700	(273)
EI value			93.1694	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	97.4452	96.6467	96.9063	96.3936	96.3936	96.1472	95.9073	95.6739	95.4472	96.1472	95.6739	96.1472	(39)
Average = Sum(39)m / 12 =												96.2441	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2214	1.2114	1.2147	1.2082	1.2082	1.2052	1.2021	1.1992	1.1964	1.2052	1.1992	1.2052	(40)
HLP (average)												1.2064	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northwest	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(81)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.0372	204.6716	321.4656	465.9871	551.6305	620.9856	583.2645	504.2878	390.7974	255.3873	159.5800	108.2337	(83)
Total gains	684.1579	753.4873	849.0455	960.6070	1012.4971	1051.5729	996.1120	925.3192	830.7536	728.5150	669.6041	646.1798	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0886	34.3703	34.2782	34.4605	34.4605	34.5488	34.6353	34.7197	34.8022	34.5488	34.7197	34.5488	
alpha	3.2726	3.2914	3.2852	3.2974	3.2974	3.3033	3.3090	3.3146	3.3201	3.3033	3.3146	3.3033	
util living area													
	0.9616	0.9471	0.9073	0.8190	0.6806	0.4903	0.3662	0.3911	0.6330	0.8490	0.9375	0.9661	(86)
MIT	19.4602	19.6379	20.0072	20.4541	20.7791	20.9449	20.9842	20.9810	20.8716	20.4832	19.9365	19.4484	(87)
Th 2	19.9029	19.9109	19.9083	19.9134	19.9134	19.9159	19.9183	19.9206	19.9229	19.9159	19.9206	19.9159	(88)
util rest of house													
	0.9539	0.9367	0.8890	0.7839	0.6210	0.4076	0.2687	0.2881	0.5506	0.8103	0.9230	0.9592	(89)
MIT 2	17.8992	18.1578	18.6779	19.2904	19.7001	19.8781	19.9117	19.9126	19.8205	19.3478	18.5958	17.8914	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2217	18.4635	18.9525	19.5308	19.9230	20.0984	20.1333	20.1333	20.0376	19.5824	18.8728	18.2130	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0717	18.3135	18.8025	19.3808	19.7730	19.9484	19.9833	19.9833	19.8876	19.4324	18.7228	18.0630	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9361	0.9165	0.8657	0.7640	0.6126	0.4102	0.2747	0.2943	0.5476	0.7895	0.9017	0.9427	(94)
Useful gains	640.4245	690.5583	735.0429	733.9182	620.2429	431.3203	273.6386	272.3293	454.9597	575.1564	603.7886	609.1319	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1283.5150	1257.7142	1143.7325	952.4450	701.0743	446.9335	276.5262	275.8536	495.1411	772.2888	1035.4554	1255.9706	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	478.4594	381.1288	304.0650	157.3393	60.1385	0.0000	0.0000	0.0000	0.0000	146.6665	310.8001	481.2480	(98)
Space heating												2319.8456	(98)
Space heating per m2											(98) / (4) =	29.0780	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2563.3653	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	478.4594	381.1288	304.0650	157.3393	60.1385	0.0000	0.0000	0.0000	0.0000	146.6665	310.8001	481.2480	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	528.6844	421.1368	335.9835	173.8555	66.4514	0.0000	0.0000	0.0000	0.0000	162.0625	343.4255	531.7658	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6567	89.5956	89.4154	89.0090	88.2978	87.3000	87.3000	87.3000	87.3000	88.9232	89.4408	89.6783	(217)
Fuel for water heating, kWh/month													
	184.2182	161.6611	168.1879	148.7703	144.9997	128.1956	120.4190	135.8687	136.8056	154.5586	165.8451	178.8464	(219)
Water heating fuel used												1828.3762	(219)
Annual totals kWh/year													
Space heating fuel - main system												2563.3653	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3448.5196	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2563.3653	10.2300	262.2323	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.3762	10.2300	187.0429	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	350.7552	36.7200	128.7973	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			205.9241	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2563.3653	0.2160	553.6869	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.3762	0.2160	394.9293	(264)
Space and water heating			948.6162	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			459.0840	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2563.3653	1.2200	3127.3057	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.3762	1.2200	2230.6190	(264)
Space and water heating			5357.9247	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	350.7552	3.0700	1076.8184	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2462.2333	(272)
Primary energy kWh/m2/year			30.8628	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (40.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£156	£175	-£18
Mains gas	£552	£452	£100
Space heating	£393	£393	£0
Water heating	£187	£106	£81
Lighting	£129	£129	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£205	£124	£82
Total cost of uses	£206	£125	£81
Delivered energy	43 kWh/m²	32 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	31 kWh/m²	18 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5012	0.4914	0.4815	0.4324	0.4226	0.3734	0.3734	0.3636	0.3931	0.4226	0.4422	0.4619	(22b)
Effective ac	0.6256	0.6207	0.6159	0.5935	0.5893	0.5697	0.5697	0.5661	0.5773	0.5893	0.5978	0.6067	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.5755	42.2436	41.9183	40.3902	40.1043	38.7734	38.7734	38.5270	39.2861	40.1043	40.6827	41.2873	(38)
Heat transfer coeff	100.1957	99.8638	99.5385	98.0104	97.7245	96.3936	96.3936	96.1472	96.9063	97.7245	98.3029	98.9075	(39)
Average = Sum(39)m / 12 =												98.0090	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2559	1.2517	1.2477	1.2285	1.2249	1.2082	1.2082	1.2052	1.2147	1.2249	1.2322	1.2398	(40)
HLP (average)												1.2285	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	657.7100	739.8062	822.9972	917.8062	987.0343	975.8951	929.0338	856.8810	779.0670	693.4059	637.6355	625.9400	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1528	33.2630	33.3717	33.8920	33.9912	34.4605	34.4605	34.5488	34.2782	33.9912	33.7912	33.5846	
alpha	3.2102	3.2175	3.2248	3.2595	3.2661	3.2974	3.2974	3.3033	3.2852	3.2661	3.2527	3.2390	
util living area													
	0.9691	0.9538	0.9226	0.8524	0.7331	0.5726	0.4372	0.4863	0.7051	0.8867	0.9535	0.9732	(86)
MIT	19.2647	19.4871	19.8517	20.3191	20.6871	20.9014	20.9695	20.9566	20.7979	20.3220	19.7216	19.2295	(87)
Th 2	19.8755	19.8788	19.8821	19.8973	19.9001	19.9134	19.9134	19.9159	19.9083	19.9001	19.8943	19.8883	(88)
util rest of house													
	0.9629	0.9447	0.9069	0.8226	0.6806	0.4931	0.3370	0.3832	0.6308	0.8569	0.9427	0.9678	(89)
MIT 2	17.6004	17.9214	18.4422	19.0995	19.5796	19.8364	19.8979	19.8919	19.7311	19.1219	18.2734	17.5578	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9442	18.2448	18.7333	19.3514	19.8084	20.0564	20.1192	20.1118	19.9515	19.3698	18.5725	17.9031	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7942	18.0948	18.5833	19.2014	19.6584	19.9064	19.9692	19.9618	19.8015	19.2198	18.4225	17.7531	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9250	0.8837	0.8003	0.6677	0.4925	0.3424	0.3878	0.6226	0.8339	0.9230	0.9529	(94)
Useful gains	622.6050	684.2976	727.2848	734.5427	659.0826	480.6618	318.0962	332.3251	485.0856	578.2641	588.5644	596.4534	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1352.0630	1317.6854	1202.7552	1009.6482	777.7284	511.5059	324.7711	342.4584	552.5101	842.3624	1113.0364	1340.5023	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	542.7168	425.6365	353.7500	198.0759	88.2725	0.0000	0.0000	0.0000	0.0000	196.4891	377.6198	553.5724	(98)
Space heating												2736.1330	(98)
Space heating per m2											(98) / (4) =	34.2960	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3023.3514	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.7168	425.6365	353.7500	198.0759	88.2725	0.0000	0.0000	0.0000	0.0000	196.4891	377.6198	553.5724	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.6871	470.3166	390.8840	218.8684	97.5386	0.0000	0.0000	0.0000	0.0000	217.1150	417.2595	611.6822	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8221	89.8531	89.8869	89.9545	90.0776	87.3000	87.3000	87.3000	87.3000	89.5071	89.7104	89.8356	(217)
Fuel for water heating, kWh/month													
	156.6508	115.7777	89.9792	43.6517	14.3763	0.0000	0.0000	24.1300	49.2919	95.2623	133.0101	155.7515	(219)
Water heating fuel used												877.8817	(219)
Annual totals kWh/year													
Space heating fuel - main system												3023.3514	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3158.4312	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3023.3514	3.4800	105.2126	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.8817	3.4800	30.5503	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	350.7552	13.1900	46.2646	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			157.7873	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5311	(257)
SAP value	92.5912	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3023.3514	0.2160	653.0439	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.8817	0.2160	189.6225	(264)
Space and water heating			842.6664	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			457.1522	(272)
CO2 emissions per m2			5.7300	(273)
EI value			95.0907	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6200	
Infiltration rate			0.4250	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3931	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4127	0.3833	0.3931	0.3734	0.3734	0.3636	0.3538	0.3439	0.3341	0.3636	0.3439	0.3636	(22b)
Effective ac	0.5852	0.5734	0.5773	0.5697	0.5697	0.5661	0.5626	0.5592	0.5558	0.5661	0.5592	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8250	39.0265	39.2861	38.7734	38.7734	38.5270	38.2871	38.0537	37.8270	38.5270	38.0537	38.5270	(38)
Heat transfer coeff	97.4452	96.6467	96.9063	96.3936	96.3936	96.1472	95.9073	95.6739	95.4472	96.1472	95.6739	96.1472	(39)
Average = Sum(39)m / 12 =												96.2441	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2214	1.2114	1.2147	1.2082	1.2082	1.2052	1.2021	1.1992	1.1964	1.2052	1.1992	1.2052	(40)
HLP (average)												1.2064	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northwest	2.1600	14.6176	0.4600	0.0000	0.7700	11.1836	(81)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.0372	204.6716	321.4656	465.9871	551.6305	620.9856	583.2645	504.2878	390.7974	255.3873	159.5800	108.2337	(83)
Total gains	684.1579	753.4873	849.0455	960.6070	1012.4971	1051.5729	996.1120	925.3192	830.7536	728.5150	669.6041	646.1798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0886	34.3703	34.2782	34.4605	34.4605	34.5488	34.6353	34.7197	34.8022	34.5488	34.7197	34.5488	
alpha	3.2726	3.2914	3.2852	3.2974	3.2974	3.3033	3.3090	3.3146	3.3201	3.3033	3.3146	3.3033	
util living area													
	0.9616	0.9471	0.9073	0.8190	0.6806	0.4903	0.3662	0.3911	0.6330	0.8490	0.9375	0.9661	(86)
MIT	19.4602	19.6379	20.0072	20.4541	20.7791	20.9449	20.9842	20.9810	20.8716	20.4832	19.9365	19.4484	(87)
Th 2	19.9029	19.9109	19.9083	19.9134	19.9134	19.9159	19.9183	19.9206	19.9229	19.9159	19.9206	19.9159	(88)
util rest of house													
	0.9539	0.9367	0.8890	0.7839	0.6210	0.4076	0.2687	0.2881	0.5506	0.8103	0.9230	0.9592	(89)
MIT 2	17.8992	18.1578	18.6779	19.2904	19.7001	19.8781	19.9117	19.9126	19.8205	19.3478	18.5958	17.8914	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2217	18.4635	18.9525	19.5308	19.9230	20.0984	20.1333	20.1333	20.0376	19.5824	18.8728	18.2130	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0717	18.3135	18.8025	19.3808	19.7730	19.9484	19.9833	19.9833	19.8876	19.4324	18.7228	18.0630	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9361	0.9165	0.8657	0.7640	0.6126	0.4102	0.2747	0.2943	0.5476	0.7895	0.9017	0.9427	(94)
Useful gains	640.4245	690.5583	735.0429	733.9182	620.2429	431.3203	273.6386	272.3293	454.9597	575.1564	603.7886	609.1319	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1283.5150	1257.7142	1143.7325	952.4450	701.0743	446.9335	276.5262	275.8536	495.1411	772.2888	1035.4554	1255.9706	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	478.4594	381.1288	304.0650	157.3393	60.1385	0.0000	0.0000	0.0000	0.0000	146.6665	310.8001	481.2480	(98)
Space heating												2319.8456	(98)
Space heating per m2											(98) / (4) =	29.0780	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2563.3653	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.4594	381.1288	304.0650	157.3393	60.1385	0.0000	0.0000	0.0000	0.0000	146.6665	310.8001	481.2480	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	528.6844	421.1368	335.9835	173.8555	66.4514	0.0000	0.0000	0.0000	0.0000	162.0625	343.4255	531.7658	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7692	89.7932	89.8103	89.8561	89.7614	87.3000	87.3000	87.3000	87.3000	89.3313	89.6153	89.7712	(217)
Fuel for water heating, kWh/month	152.1703	116.0757	89.7241	42.5534	19.3947	0.0000	0.0000	17.2721	43.9527	91.1168	127.8263	152.4991	(219)
Water heating fuel used												852.5852	(219)
Annual totals kWh/year													
Space heating fuel - main system												2563.3653	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2522.7285	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2563.3653	10.2300	262.2323	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.5852	10.2300	87.2195	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	350.7552	36.7200	128.7973	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			124.4606	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2563.3653	0.2160	553.6869	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.5852	0.2160	184.1584	(264)
Space and water heating			737.8453	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			274.2631	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2563.3653	1.2200	3127.3057	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.5852	1.2200	1040.1539	(264)
Space and water heating			4167.4596	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	350.7552	3.0700	1076.8184	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1425.2682	(272)
Primary energy kWh/m2/year			17.8650	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	149.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	57.62	(37)
Summer heat loss coefficient	329.85	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	2.1600	98.8453	0.4600	0.0000	0.9000	88.3914
North East	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						646.9333

	Jun	Jul	Aug	
Solar gains	691	647	558	(P4)
Internal gains	428	410	418	
Total summer gains	1119	1057	976	(P5)
Summer gain/loss ratio	3.39	3.20	2.96	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.9)	0.95	0.95	0.95	
Threshold temperature	20.34	22.05	21.71	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-338	**Issued on Date**	18/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-END
Property	18, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	92 A	**DER**	9.17	**TER**	18.50
Environmental	93 A	**% DER<TER**	50.42		
CO_2 Emissions (t/year)	0.43	**DFEE**	45.30	**TFEE**	52.50
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.73		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

End-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.50 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.17 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.85 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 7.51 m², No overhang
Windows facing South West: 0.72 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8500	
Infiltration rate		0.4365	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5147	0.5047	0.4946	0.4441	0.4340	0.3835	0.3835	0.3734	0.4037	0.4340	0.4542	0.4744	(22b)
Effective ac	0.6325	0.6273	0.6223	0.5986	0.5942	0.5736	0.5736	0.5697	0.5815	0.5942	0.6031	0.6125	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0444	42.6943	42.3511	40.7392	40.4376	39.0337	39.0337	38.7737	39.5745	40.4376	41.0477	41.6856	(38)
Heat transfer coeff	98.9260	98.5759	98.2327	96.6208	96.3193	94.9154	94.9154	94.6554	95.4561	96.3193	96.9294	97.5672	(39)
Average = Sum(39)m / 12 =												96.6194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2400	1.2356	1.2313	1.2111	1.2073	1.1897	1.1897	1.1865	1.1965	1.2073	1.2150	1.2230	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	501.7960	596.0450	682.7893	768.3890	825.3948	812.4274	775.0047	720.1572	657.9433	571.1308	498.0725	471.3869	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7898	33.9098	34.0283	34.5960	34.7043	35.2176	35.2176	35.3144	35.0181	34.7043	34.4859	34.2604	
alpha	3.2527	3.2607	3.2686	3.3064	3.3136	3.3478	3.3478	3.3543	3.3345	3.3136	3.2991	3.2840	
util living area													
	0.9855	0.9740	0.9508	0.8976	0.7986	0.6484	0.5052	0.5548	0.7697	0.9267	0.9760	0.9880	(86)
MIT	19.0611	19.3122	19.6987	20.1910	20.6002	20.8630	20.9557	20.9391	20.7421	20.2019	19.5481	19.0259	(87)
Th 2	19.8881	19.8916	19.8950	19.9111	19.9142	19.9282	19.9282	19.9309	19.9228	19.9142	19.9081	19.9017	(88)
util rest of house													
	0.9823	0.9684	0.9400	0.8743	0.7517	0.5674	0.3954	0.4445	0.7007	0.9051	0.9700	0.9855	(89)
MIT 2	17.3144	17.6798	18.2378	18.9420	19.4917	19.8170	19.9047	19.8957	19.6876	18.9735	18.0355	17.2714	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6752	18.0170	18.5396	19.2000	19.7207	20.0331	20.1218	20.1112	19.9055	19.2272	18.3480	17.6339	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5252	17.8670	18.3896	19.0500	19.5707	19.8831	19.9718	19.9612	19.7555	19.0772	18.1980	17.4839	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9539	0.9201	0.8514	0.7345	0.5637	0.4001	0.4478	0.6883	0.8830	0.9561	0.9767	(94)
Useful gains	487.8592	568.5419	628.2100	654.2117	606.2573	457.9496	310.0984	322.5013	452.8387	504.3244	476.1857	460.4155	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1308.3179	1278.2337	1167.9457	980.7054	758.0954	501.4460	320.0374	337.0885	539.8474	816.5199	1075.7183	1296.0692	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	610.4213	476.9129	401.5633	235.0755	112.9675	0.0000	0.0000	0.0000	0.0000	232.2735	431.6634	621.7264	(98)
Space heating												3122.6037	(98)
Space heating per m2											(98) / (4) =	39.1402	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3450.3909	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	610.4213	476.9129	401.5633	235.0755	112.9675	0.0000	0.0000	0.0000	0.0000	232.2735	431.6634	621.7264	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	674.4986	526.9756	443.7164	259.7519	124.8260	0.0000	0.0000	0.0000	0.0000	256.6558	476.9762	686.9904	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7990	89.7338	89.6051	89.3203	88.7713	87.3000	87.3000	87.3000	87.3000	89.2834	89.6595	89.8248	(217)
Fuel for water heating, kWh/month													
	183.9261	161.4122	167.8318	148.2519	144.2263	128.1956	120.4190	135.8687	136.8056	153.9351	165.4406	178.5548	(219)
Water heating fuel used												1824.8676	(219)
Annual totals kWh/year													
Space heating fuel - main system												3450.3909	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4488.6141	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3450.3909	0.2160	745.2844	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.8676	0.2160	394.1714	(264)
Space and water heating			1139.4558	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			731.1874	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.1700	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.6663	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.6663	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	496.6883	577.4054	649.7721	720.0207	765.5497	750.8193	716.6442	670.7669	619.2540	547.9880	489.0334	468.9134	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9976	0.9946	0.9863	0.9578	0.8778	0.7162	0.5472	0.6020	0.8433	0.9732	0.9950	0.9982	(86)
MIT	19.7307	19.8940	20.1528	20.4915	20.7785	20.9445	20.9884	20.9817	20.8690	20.4959	20.0534	19.7062	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9968	0.9928	0.9813	0.9417	0.8320	0.6242	0.4255	0.4781	0.7704	0.9599	0.9930	0.9976	(89)
MIT 2	18.2444	18.4844	18.8617	19.3529	19.7344	19.9270	19.9597	19.9586	19.8544	19.3683	18.7275	18.2165	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9899	0.9762	0.9348	0.8319	0.6408	0.4507	0.5037	0.7788	0.9539	0.9903	0.9964	(94)
Useful gains	494.3401	571.5852	634.2787	673.0433	636.8640	481.1135	323.0045	337.8494	482.2926	522.7404	484.2943	467.2213	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1349.1222	1309.5523	1188.2896	991.5654	763.3452	505.9492	326.4037	343.6666	547.5953	832.8467	1107.1433	1340.0354	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating												3196.0378	(98)
Space heating per m2											(98) / (4) =	40.0606	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3421.8820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	680.8971	530.9570	441.3106	245.5417	100.7516	0.0000	0.0000	0.0000	0.0000	247.0226	480.1406	695.2609	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7397	87.5017	87.0164	85.9015	83.7889	80.3000	80.3000	80.3000	80.3000	85.7982	87.2194	87.8264	(217)
Fuel for water heating, kWh/month													
	230.2308	202.6021	211.9699	190.4467	189.0350	173.7253	166.4421	185.5439	187.5930	199.9232	209.9365	224.5768	(219)
Water heating fuel used												2372.0253	(219)
Annual totals kWh/year													
Space heating fuel - main system												3421.8820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6225.8200	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3421.8820	0.2160	739.1265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2372.0253	0.2160	512.3575	(264)
Space and water heating			1251.4840	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1475.6466	(272)
Emissions per m2 for space and water heating			15.6867	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6867 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.8500	
Infiltration rate			0.3880	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3589	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4576	0.4486	0.4396	0.3948	0.3858	0.3409	0.3409	0.3320	0.3589	0.3858	0.4037	0.4217	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1523	40.8757	40.6045	39.3309	39.0926	37.9833	37.9833	37.7779	38.4106	39.0926	39.5747	40.0786	(38)
Heat transfer coeff	97.0340	96.7573	96.4862	95.2125	94.9742	93.8649	93.8649	93.6595	94.2922	94.9742	95.4563	95.9603	(39)
Average = Sum(39)m / 12 =												95.2114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2163	1.2128	1.2094	1.1934	1.1905	1.1765	1.1765	1.1740	1.1819	1.1905	1.1965	1.2028	(40)
HLP (average)												1.1934	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	469.6896	564.7166	653.0758	740.8688	799.2992	788.3357	752.6134	695.5841	632.5928	543.5107	467.8893	440.0531	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4487	34.5472	34.6443	35.1077	35.1958	35.6117	35.6117	35.6898	35.4504	35.1958	35.0181	34.8341	
alpha	3.2966	3.3031	3.3096	3.3405	3.3464	3.3741	3.3741	3.3793	3.3634	3.3464	3.3345	3.3223	
util living area													
	0.9880	0.9774	0.9555	0.9042	0.8068	0.6578	0.5135	0.5661	0.7815	0.9342	0.9797	0.9902	(86)
MIT	19.0511	19.3033	19.6915	20.1826	20.5955	20.8601	20.9548	20.9369	20.7343	20.1856	19.5288	19.0105	(87)
Th 2	19.9070	19.9098	19.9125	19.9253	19.9276	19.9388	19.9388	19.9409	19.9345	19.9276	19.9228	19.9178	(88)
util rest of house													
	0.9854	0.9725	0.9456	0.8822	0.7611	0.5774	0.4035	0.4555	0.7144	0.9144	0.9746	0.9881	(89)
MIT 2	18.1347	18.3864	18.7702	19.2536	19.6340	19.8606	19.9222	19.9157	19.7674	19.2678	18.6218	18.1023	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3240	18.5758	18.9605	19.4455	19.8326	20.0671	20.1355	20.1266	19.9672	19.4574	18.8091	18.2899	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3240	18.5758	18.9605	19.4455	19.8326	20.0671	20.1355	20.1266	19.9672	19.4574	18.8091	18.2899	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9802	0.9647	0.9347	0.8704	0.7566	0.5879	0.4249	0.4762	0.7167	0.9035	0.9674	0.9837	(94)
Useful gains	460.3679	544.7681	610.4180	644.8611	604.7253	463.4954	319.8189	331.2538	453.3824	491.0604	452.6272	432.8697	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1360.8062	1323.2340	1202.2696	1004.0623	772.3920	513.1664	331.8635	349.0356	553.2272	841.2221	1117.7099	1352.0681	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	669.9262	523.1291	440.3376	258.6248	124.7440	0.0000	0.0000	0.0000	0.0000	260.5203	478.8595	683.8836	(98)
Space heating												3440.0251	(98)
Space heating per m2											(98) / (4) =	43.1189	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calculated for June, July and August. See Table 10b												
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	882.3303	694.6004	711.8122	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8216	0.8801	0.8542	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	724.9250	611.3318	607.9972	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1013.3648	969.7378	904.7039	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	207.6767	266.6541	220.7498	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												695.0805	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	51.9192	66.6635	55.1875	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												173.7701	(107)
Space cooling per m2												2.1781	(108)
Energy for space heating												43.1189	(99)
Energy for space cooling												2.1781	(108)
Total												45.2970	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	452.2029	534.0089	608.6129	681.6749	729.2529	717.1489	684.6671	635.9860	583.0680	508.9123	446.7765	425.1967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9962	0.9895	0.9655	0.8939	0.7395	0.5700	0.6296	0.8666	0.9800	0.9967	0.9989	(86)
MIT	19.6793	19.8444	20.1076	20.4546	20.7548	20.9358	20.9861	20.9777	20.8490	20.4553	20.0049	19.6554	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9979	0.9949	0.9857	0.9519	0.8517	0.6482	0.4445	0.5026	0.7987	0.9696	0.9953	0.9985	(89)
MIT 2	18.7281	18.8950	19.1585	19.5080	19.7849	19.9342	19.9605	19.9597	19.8744	19.5153	19.0664	18.7132	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9934	0.9828	0.9479	0.8532	0.6651	0.4707	0.5290	0.8076	0.9664	0.9940	0.9979	(94)
Useful gains	450.9374	530.4905	598.1683	646.1725	622.1983	477.0035	322.2893	336.4477	470.8958	491.8343	444.0959	424.3159	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1384.4456	1339.3349	1209.5657	1002.2755	766.5973	506.3064	326.4131	343.6723	548.6728	842.8616	1131.2257	1375.9188	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.5301	543.5435	454.8797	256.3942	107.4329	0.0000	0.0000	0.0000	0.0000	261.1644	494.7334	707.9925	(98)
Space heating												3520.6706	(98)
Space heating per m2											(98) / (4) =	44.1297	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8659	0.9259	0.9020	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	743.7160	626.0361	624.9430	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	930.1594	890.3200	835.0439	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	134.2393	196.6272	156.3150	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												487.1815	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	33.5598	49.1568	39.0788	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												121.7954 (107)
Space cooling per m2												1.5266 (108)
Energy for space heating												44.1297 (99)
Energy for space cooling												1.5266 (108)
Total												45.6564 (109)
Target Fabric Energy Efficiency (TFEE)												52.5 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8500	
Infiltration rate		0.4365	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4239	0.3936	0.4037	0.3835	0.3835	0.3734	0.3634	0.3533	0.3432	0.3734	0.3533	0.3734	(22b)
Effective ac	0.5898	0.5775	0.5815	0.5736	0.5736	0.5697	0.5660	0.5624	0.5589	0.5697	0.5624	0.5697	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1430	39.3006	39.5745	39.0337	39.0337	38.7737	38.5207	38.2746	38.0354	38.7737	38.2746	38.7737	(38)
Heat transfer coeff	96.0246	95.1823	95.4561	94.9154	94.9154	94.6554	94.4023	94.1562	93.9170	94.6554	94.1562	94.6554	(39)
Average = Sum(39)m / 12 =												94.7576	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2036	1.1931	1.1965	1.1897	1.1897	1.1865	1.1833	1.1802	1.1772	1.1865	1.1802	1.1865	(40)
HLP (average)												1.1877	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)
Total per year (kWh/year) = Sum(64)m =												1622.0849 (64)
RHI water heating demand												1622 (64)
Heat gains from water heating, kWh/month												
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	157.8949	236.5519	347.1161	468.2205	529.1030	585.0786	553.6901	495.9108	409.4920	288.0496	190.1260	131.8038	(83)
Total gains	711.8873	786.1418	875.3256	963.3171	990.3260	1015.9668	966.8627	917.3647	850.0153	761.8973	700.9905	670.6458	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8108	35.1189	35.0181	35.2176	35.2176	35.3144	35.4090	35.5016	35.5920	35.3144	35.5016	35.3144	
alpha	3.3207	3.3413	3.3345	3.3478	3.3478	3.3543	3.3606	3.3668	3.3728	3.3543	3.3668	3.3543	
util living area													
	0.9574	0.9409	0.8998	0.8156	0.6858	0.4992	0.3715	0.3891	0.6177	0.8330	0.9296	0.9627	(86)
MIT	19.5384	19.7204	20.0704	20.4809	20.7834	20.9451	20.9847	20.9825	20.8865	20.5346	20.0102	19.5242	(87)
Th 2	19.9171	19.9256	19.9228	19.9282	19.9282	19.9309	19.9334	19.9359	19.9383	19.9309	19.9359	19.9309	(88)
util rest of house													
	0.9490	0.9296	0.8805	0.7803	0.6267	0.4164	0.2740	0.2878	0.5363	0.7922	0.9137	0.9551	(89)
MIT 2	18.0190	18.2833	18.7744	19.3364	19.7185	19.8929	19.9270	19.9284	19.8483	19.4236	18.7080	18.0085	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3329	18.5802	19.0421	19.5728	19.9385	20.1103	20.1454	20.1462	20.0628	19.6531	18.9770	18.3216	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1829	18.4302	18.8921	19.4228	19.7885	19.9603	19.9954	19.9962	19.9128	19.5031	18.8270	18.1716	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9090	0.8577	0.7612	0.6183	0.4188	0.2798	0.2937	0.5342	0.7729	0.8923	0.9381	(94)
Useful gains	662.5551	714.6157	750.7331	733.3161	612.3456	425.5035	270.5163	269.4512	454.1028	588.8739	625.4757	629.1355	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1275.4817	1249.7589	1135.1726	941.8299	691.7883	441.1179	273.3367	272.6932	489.5697	766.9977	1028.8467	1246.7637	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	456.0174	359.6163	286.0229	150.1299	59.1054	0.0000	0.0000	0.0000	0.0000	132.5241	290.4271	459.5154	(98)
Space heating												2193.3584	(98)
RHI space heating demand												2193	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8500	
Infiltration rate		0.4365	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5147	0.5047	0.4946	0.4441	0.4340	0.3835	0.3835	0.3734	0.4037	0.4340	0.4542	0.4744	(22b)
Effective ac	0.6325	0.6273	0.6223	0.5986	0.5942	0.5736	0.5736	0.5697	0.5815	0.5942	0.6031	0.6125	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0444	42.6943	42.3511	40.7392	40.4376	39.0337	39.0337	38.7737	39.5745	40.4376	41.0477	41.6856	(38)
Heat transfer coeff	98.9260	98.5759	98.2327	96.6208	96.3193	94.9154	94.9154	94.6554	95.4561	96.3193	96.9294	97.5672	(39)
Average = Sum(39)m / 12 =												96.6194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2400	1.2356	1.2313	1.2111	1.2073	1.1897	1.1897	1.1865	1.1965	1.2073	1.2150	1.2230	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	681.4708	773.4495	852.3453	926.6212	971.8621	949.8411	908.5021	855.9248	801.5595	726.0707	664.7774	647.1454	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7898	33.9098	34.0283	34.5960	34.7043	35.2176	35.2176	35.3144	35.0181	34.7043	34.4859	34.2604	
alpha	3.2527	3.2607	3.2686	3.3064	3.3136	3.3478	3.3478	3.3543	3.3345	3.3136	3.2991	3.2840	
util living area													
	0.9662	0.9484	0.9156	0.8480	0.7359	0.5793	0.4406	0.4814	0.6889	0.8738	0.9483	0.9709	(86)
MIT	19.3358	19.5687	19.9190	20.3530	20.6950	20.9029	20.9706	20.9603	20.8197	20.3795	19.7913	19.2994	(87)
Th 2	19.8881	19.8916	19.8950	19.9111	19.9142	19.9282	19.9282	19.9309	19.9228	19.9142	19.9081	19.9017	(88)
util rest of house													
	0.9596	0.9384	0.8990	0.8178	0.6839	0.5002	0.3410	0.3801	0.6146	0.8420	0.9365	0.9650	(89)
MIT 2	17.7093	18.0446	18.5437	19.1544	19.6012	19.8521	19.9132	19.9089	19.7660	19.2070	18.3798	17.6657	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0453	18.3595	18.8278	19.4020	19.8272	20.0691	20.1316	20.1260	19.9837	19.4492	18.6714	18.0031	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8953	18.2095	18.6778	19.2520	19.6772	19.9191	19.9816	19.9760	19.8337	19.2992	18.5214	17.8531	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9181	0.8758	0.7962	0.6713	0.4995	0.3462	0.3846	0.6078	0.8199	0.9164	0.9497	(94)
Useful gains	642.4753	710.1070	746.5203	737.7957	652.4175	474.4083	314.5228	329.2178	487.1616	595.2903	609.2024	614.5888	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1344.9266	1311.9931	1196.2587	1000.2190	768.3535	504.8678	320.9664	338.4921	547.3131	837.9021	1107.0676	1332.0972	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	522.6238	404.4675	334.6053	188.9448	86.2564	0.0000	0.0000	0.0000	0.0000	180.5032	358.4629	533.8262	(98)
Space heating												2609.6902	(98)
Space heating per m2											(98) / (4) =	32.7111	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2883.6355	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	522.6238	404.4675	334.6053	188.9448	86.2564	0.0000	0.0000	0.0000	0.0000	180.5032	358.4629	533.8262	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	577.4848	446.9254	369.7297	208.7788	95.3109	0.0000	0.0000	0.0000	0.0000	199.4511	396.0916	589.8632	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7103	89.6337	89.4829	89.1534	88.5605	87.3000	87.3000	87.3000	87.3000	89.0884	89.5394	89.7400	(217)
Fuel for water heating, kWh/month													
	184.1080	161.5924	168.0609	148.5293	144.5697	128.1956	120.4190	135.8687	136.8056	154.2720	165.6626	178.7235	(219)
Water heating fuel used												1826.8072	(219)
Annual totals kWh/year													
Space heating fuel - main system												2883.6355	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3923.7983	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2883.6355	3.4800	100.3505	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.8072	3.4800	63.5729	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			180.1650	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6064	(257)
SAP value		91.5404	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2883.6355	0.2160	622.8653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.8072	0.2160	394.5904	(264)
Space and water heating			1017.4556	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			609.1872	(272)
CO2 emissions per m2			7.6400	(273)
EI value			93.4580	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8500	
Infiltration rate			0.4365	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4239	0.3936	0.4037	0.3835	0.3835	0.3734	0.3634	0.3533	0.3432	0.3734	0.3533	0.3734	(22b)
Effective ac	0.5898	0.5775	0.5815	0.5736	0.5736	0.5697	0.5660	0.5624	0.5589	0.5697	0.5624	0.5697	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1430	39.3006	39.5745	39.0337	39.0337	38.7737	38.5207	38.2746	38.0354	38.7737	38.2746	38.7737	(38)
Heat transfer coeff	96.0246	95.1823	95.4561	94.9154	94.9154	94.6554	94.4023	94.1562	93.9170	94.6554	94.1562	94.6554	(39)
Average = Sum(39)m / 12 =												94.7576	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2036	1.1931	1.1965	1.1897	1.1897	1.1865	1.1833	1.1802	1.1772	1.1865	1.1802	1.1865	(40)
HLP (average)												1.1877	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	157.8949	236.5519	347.1161	468.2205	529.1030	585.0786	553.6901	495.9108	409.4920	288.0496	190.1260	131.8038	(83)
Total gains	711.8873	786.1418	875.3256	963.3171	990.3260	1015.9668	966.8627	917.3647	850.0153	761.8973	700.9905	670.6458	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8108	35.1189	35.0181	35.2176	35.2176	35.3144	35.4090	35.5016	35.5920	35.3144	35.5016	35.3144	
alpha	3.3207	3.3413	3.3345	3.3478	3.3478	3.3543	3.3606	3.3668	3.3728	3.3543	3.3668	3.3543	
util living area													
	0.9574	0.9409	0.8998	0.8156	0.6858	0.4992	0.3715	0.3891	0.6177	0.8330	0.9296	0.9627	(86)
MIT	19.5384	19.7204	20.0704	20.4809	20.7834	20.9451	20.9847	20.9825	20.8865	20.5346	20.0102	19.5242	(87)
Th 2	19.9171	19.9256	19.9228	19.9282	19.9282	19.9309	19.9334	19.9359	19.9383	19.9309	19.9359	19.9309	(88)
util rest of house													
	0.9490	0.9296	0.8805	0.7803	0.6267	0.4164	0.2740	0.2878	0.5363	0.7922	0.9137	0.9551	(89)
MIT 2	18.0190	18.2833	18.7744	19.3364	19.7185	19.8929	19.9270	19.9284	19.8483	19.4236	18.7080	18.0085	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.3329	18.5802	19.0421	19.5728	19.9385	20.1103	20.1454	20.1462	20.0628	19.6531	18.9770	18.3216	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1829	18.4302	18.8921	19.4228	19.7885	19.9603	19.9954	19.9962	19.9128	19.5031	18.8270	18.1716	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9090	0.8577	0.7612	0.6183	0.4188	0.2798	0.2937	0.5342	0.7729	0.8923	0.9381	(94)
Useful gains	662.5551	714.6157	750.7331	733.3161	612.3456	425.5035	270.5163	269.4512	454.1028	588.8739	625.4757	629.1355	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1275.4817	1249.7589	1135.1726	941.8299	691.7883	441.1179	273.3367	272.6932	489.5697	766.9977	1028.8467	1246.7637	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	456.0174	359.6163	286.0229	150.1299	59.1054	0.0000	0.0000	0.0000	0.0000	132.5241	290.4271	459.5154	(98)
Space heating												2193.3584	(98)
Space heating per m2											(98) / (4) =	27.4926	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2423.6005	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	456.0174	359.6163	286.0229	150.1299	59.1054	0.0000	0.0000	0.0000	0.0000	132.5241	290.4271	459.5154	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	503.8866	397.3661	316.0474	165.8894	65.3098	0.0000	0.0000	0.0000	0.0000	146.4355	320.9139	507.7518	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6265	89.5574	89.3711	88.9716	88.2860	87.3000	87.3000	87.3000	87.3000	88.8421	89.3922	89.6498	(217)
Fuel for water heating, kWh/month													
	184.2802	161.7300	168.2712	148.8329	145.0192	128.1956	120.4190	135.8687	136.8056	154.6997	165.9352	178.9034	(219)
Water heating fuel used												1828.9606	(219)
Annual totals kWh/year													
Space heating fuel - main system												2423.6005	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3315.4966	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2423.6005	10.2300	247.9343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.9606	10.2300	187.1027	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			193.9469	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2423.6005	0.2160	523.4977	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9606	0.2160	395.0555	(264)
Space and water heating			918.5532	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			432.2167	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2423.6005	1.2200	2956.7926	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9606	1.2200	2231.3319	(264)
Space and water heating			5188.1245	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2311.3366	(272)
Primary energy kWh/m2/year			28.9714	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (42.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£538	£438	£100
Space heating	£378	£378	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£194	£112	£82
Total cost of uses	£193	£112	£81
Delivered energy	42 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8500	
Infiltration rate			0.4365	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5147	0.5047	0.4946	0.4441	0.4340	0.3835	0.3835	0.3734	0.4037	0.4340	0.4542	0.4744	(22b)
Effective ac	0.6325	0.6273	0.6223	0.5986	0.5942	0.5736	0.5736	0.5697	0.5815	0.5942	0.6031	0.6125	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.0444	42.6943	42.3511	40.7392	40.4376	39.0337	39.0337	38.7737	39.5745	40.4376	41.0477	41.6856	(38)
Heat transfer coeff	98.9260	98.5759	98.2327	96.6208	96.3193	94.9154	94.9154	94.6554	95.4561	96.3193	96.9294	97.5672	(39)
Average = Sum(39)m / 12 =												96.6194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2400	1.2356	1.2313	1.2111	1.2073	1.1897	1.1897	1.1865	1.1965	1.2073	1.2150	1.2230	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input

	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)

Solar input (sum of months) = Sum(63)m = -843.3953 (63)

Output from w/h

	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034 (83)
Total gains	681.4708	773.4495	852.3453	926.6212	971.8621	949.8411	908.5021	855.9248	801.5595	726.0707	664.7774	647.1454 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7898	33.9098	34.0283	34.5960	34.7043	35.2176	35.2176	35.3144	35.0181	34.7043	34.4859	34.2604	
alpha	3.2527	3.2607	3.2686	3.3064	3.3136	3.3478	3.3478	3.3543	3.3345	3.3136	3.2991	3.2840	
util living area	0.9662	0.9484	0.9156	0.8480	0.7359	0.5793	0.4406	0.4814	0.6889	0.8738	0.9483	0.9709	(86)
MIT	19.3358	19.5687	19.9190	20.3530	20.6950	20.9029	20.9706	20.9603	20.8197	20.3795	19.7913	19.2994	(87)
Th 2	19.8881	19.8916	19.8950	19.9111	19.9142	19.9282	19.9282	19.9309	19.9228	19.9142	19.9081	19.9017	(88)
util rest of house	0.9596	0.9384	0.8990	0.8178	0.6839	0.5002	0.3410	0.3801	0.6146	0.8420	0.9365	0.9650	(89)
MIT 2	17.7093	18.0446	18.5437	19.1544	19.6012	19.8521	19.9132	19.9089	19.7660	19.2070	18.3798	17.6657	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0453	18.3595	18.8278	19.4020	19.8272	20.0691	20.1316	20.1260	19.9837	19.4492	18.6714	18.0031	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8953	18.2095	18.6778	19.2520	19.6772	19.9191	19.9816	19.9760	19.8337	19.2992	18.5214	17.8531	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9181	0.8758	0.7962	0.6713	0.4995	0.3462	0.3846	0.6078	0.8199	0.9164	0.9497	(94)
Useful gains	642.4753	710.1070	746.5203	737.7957	652.4175	474.4083	314.5228	329.2178	487.1616	595.2903	609.2024	614.5888	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1344.9266	1311.9931	1196.2587	1000.2190	768.3535	504.8678	320.9664	338.4921	547.3131	837.9021	1107.0676	1332.0972	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	522.6238	404.4675	334.6053	188.9448	86.2564	0.0000	0.0000	0.0000	0.0000	180.5032	358.4629	533.8262	(98)
Space heating												2609.6902	(98)
Space heating per m2											(98) / (4) =	32.7111	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2883.6355	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	522.6238	404.4675	334.6053	188.9448	86.2564	0.0000	0.0000	0.0000	0.0000	180.5032	358.4629	533.8262	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	577.4848	446.9254	369.7297	208.7788	95.3109	0.0000	0.0000	0.0000	0.0000	199.4511	396.0916	589.8632	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8018	89.8264	89.8588	89.9328	90.0690	87.3000	87.3000	87.3000	87.3000	89.4481	89.6790	89.8163	(217)
Fuel for water heating, kWh/month	156.6864	115.8122	90.0073	43.6623	14.3777	0.0000	0.0000	24.1300	49.2919	95.3252	133.0567	155.7850	(219)
Water heating fuel used												878.1346	(219)
Annual totals kWh/year													
Space heating fuel - main system												2883.6355	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3025.1257	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2883.6355	3.4800	100.3505	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.1346	3.4800	30.5591	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			153.7462	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5175	(257)
SAP value	92.7809	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2883.6355	0.2160	622.8653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.1346	0.2160	189.6771	(264)
Space and water heating			812.5424	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			430.2239	(272)
CO2 emissions per m2			5.3900	(273)
EI value			95.3799	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8500	
Infiltration rate		0.4365	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4037	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4239	0.3936	0.4037	0.3835	0.3835	0.3734	0.3634	0.3533	0.3432	0.3734	0.3533	0.3734	(22b)
Effective ac	0.5898	0.5775	0.5815	0.5736	0.5736	0.5697	0.5660	0.5624	0.5589	0.5697	0.5624	0.5697	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.1430	39.3006	39.5745	39.0337	39.0337	38.7737	38.5207	38.2746	38.0354	38.7737	38.2746	38.7737	(38)
Heat transfer coeff	96.0246	95.1823	95.4561	94.9154	94.9154	94.6554	94.4023	94.1562	93.9170	94.6554	94.1562	94.6554	(39)
Average = Sum(39)m / 12 =												94.7576	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2036	1.1931	1.1965	1.1897	1.1897	1.1865	1.1833	1.1802	1.1772	1.1865	1.1802	1.1865	(40)
HLP (average)												1.1877	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3932 (H8)
Utilisation factor	0.5122 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-875.5295 (H17)

Solar input -28.5619 -40.6132 -69.8043 -94.1822 -110.6226 -118.1624 -115.6775 -103.5348 -81.0606 -56.0425 -33.7812 -23.4862 (63)
Solar input (sum of months) = Sum(63)m = -875.5295 (63)
Output from w/h

	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003 (64)

Total per year (kWh/year) = Sum(64)m = 763.3548 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

---

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	157.8949	236.5519	347.1161	468.2205	529.1030	585.0786	553.6901	495.9108	409.4920	288.0496	190.1260	131.8038	(83)
Total gains	711.8873	786.1418	875.3256	963.3171	990.3260	1015.9668	966.8627	917.3647	850.0153	761.8973	700.9905	670.6458	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8108	35.1189	35.0181	35.2176	35.2176	35.3144	35.4090	35.5016	35.5920	35.3144	35.5016	35.3144	
alpha	3.3207	3.3413	3.3345	3.3478	3.3478	3.3543	3.3606	3.3668	3.3728	3.3543	3.3668	3.3543	
util living area													
	0.9574	0.9409	0.8998	0.8156	0.6858	0.4992	0.3715	0.3891	0.6177	0.8330	0.9296	0.9627	(86)
MIT	19.5384	19.7204	20.0704	20.4809	20.7834	20.9451	20.9847	20.9825	20.8865	20.5346	20.0102	19.5242	(87)
Th 2	19.9171	19.9256	19.9228	19.9282	19.9282	19.9309	19.9334	19.9359	19.9383	19.9309	19.9359	19.9309	(88)
util rest of house													
	0.9490	0.9296	0.8805	0.7803	0.6267	0.4164	0.2740	0.2878	0.5363	0.7922	0.9137	0.9551	(89)
MIT 2	18.0190	18.2833	18.7744	19.3364	19.7185	19.8929	19.9270	19.9284	19.8483	19.4236	18.7080	18.0085	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3329	18.5802	19.0421	19.5728	19.9385	20.1103	20.1454	20.1462	20.0628	19.6531	18.9770	18.3216	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1829	18.4302	18.8921	19.4228	19.7885	19.9603	19.9954	19.9962	19.9128	19.5031	18.8270	18.1716	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9090	0.8577	0.7612	0.6183	0.4188	0.2798	0.2937	0.5342	0.7729	0.8923	0.9381	(94)
Useful gains	662.5551	714.6157	750.7331	733.3161	612.3456	425.5035	270.5163	269.4512	454.1028	588.8739	625.4757	629.1355	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1275.4817	1249.7589	1135.1726	941.8299	691.7883	441.1179	273.3367	272.6932	489.5697	766.9977	1028.8467	1246.7637	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	456.0174	359.6163	286.0229	150.1299	59.1054	0.0000	0.0000	0.0000	0.0000	132.5241	290.4271	459.5154	(98)
Space heating												2193.3584	(98)
Space heating per m2											(98) / (4) =	27.4926	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2423.6005	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	456.0174	359.6163	286.0229	150.1299	59.1054	0.0000	0.0000	0.0000	0.0000	132.5241	290.4271	459.5154	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	503.8866	397.3661	316.0474	165.8894	65.3098	0.0000	0.0000	0.0000	0.0000	146.4355	320.9139	507.7518	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7418	89.7607	89.7767	89.8316	89.7515	87.3000	87.3000	87.3000	87.3000	89.2551	89.5713	89.7449	(217)
Fuel for water heating, kWh/month	152.2168	116.1177	89.7578	42.5650	19.3969	0.0000	0.0000	17.2721	43.9527	91.1946	127.8892	152.5438	(219)
Water heating fuel used												852.9065	(219)

Annual totals kWh/year		
Space heating fuel - main system	2423.6005	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =	-1368.9771	(233)
Total delivered energy for all uses	2389.4425	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2423.6005	10.2300	247.9343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.9065	10.2300	87.2523	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			112.4566	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2423.6005	0.2160	523.4977	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.9065	0.2160	184.2278	(264)
Space and water heating			707.7255	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			247.3390 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2423.6005	1.2200	2956.7926	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.9065	1.2200	1040.5459	(264)
Space and water heating			3997.3385	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1274.0506	(272)
Primary energy kWh/m2/year			15.9695	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
South West	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						615.6668

	Jun	Jul	Aug	
Solar gains	652	616	551	(P4)
Internal gains	428	410	418	
Total summer gains	1080	1026	969	(P5)
Summer gain/loss ratio	3.29	3.13	2.95	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.24	21.97	21.70	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-339	**Issued on Date**	18/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As/Opp-MID
Property	17, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	93 A	**DER**	7.35	**TER**	17.02
Environmental	95 A	**% DER<TER**	56.82		
CO_2 Emissions (t/year)	0.31	**DFEE**	36.94	**TFEE**	44.58
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.15		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Mid-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 7.35 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)44.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)36.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.34 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South East: 7.51 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.3400	
Infiltration rate		0.4110	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4454	0.4366	0.4279	0.3842	0.3755	0.3318	0.3318	0.3231	0.3493	0.3755	0.3930	0.4104	(22b)
Effective ac	0.5992	0.5953	0.5916	0.5738	0.5705	0.5551	0.5551	0.5522	0.5610	0.5705	0.5772	0.5842	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7779	40.5158	40.2589	39.0522	38.8264	37.7754	37.7754	37.5808	38.1803	38.8264	39.2832	39.7607	(38)
Heat transfer coeff	84.4522	84.1901	83.9332	82.7265	82.5007	81.4497	81.4497	81.2551	81.8545	82.5007	82.9574	83.4349	(39)
Average = Sum(39)m / 12 =												82.7254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0586	1.0553	1.0521	1.0369	1.0341	1.0209	1.0209	1.0185	1.0260	1.0341	1.0398	1.0458	(40)
HLP (average)												1.0369	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.5374	372.3806	358.8122	336.9846	314.8455	293.5503	279.7572	285.7928	297.0501	319.0892	344.3715	363.3094	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	492.6324	580.2569	661.0790	741.4125	795.1340	782.3721	746.0370	693.6416	634.4068	553.6474	487.0453	463.5826	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6131	38.7333	38.8519	39.4186	39.5265	40.0365	40.0365	40.1324	39.8385	39.5265	39.3089	39.0839	
alpha	3.5742	3.5822	3.5901	3.6279	3.6351	3.6691	3.6691	3.6755	3.6559	3.6351	3.6206	3.6056	
util living area													
	0.9847	0.9720	0.9456	0.8838	0.7700	0.6073	0.4629	0.5117	0.7374	0.9169	0.9740	0.9875	(86)
MIT	19.3450	19.5831	19.9393	20.3778	20.7209	20.9166	20.9764	20.9660	20.8250	20.3691	19.7796	19.3056	(87)
Th 2	20.0348	20.0375	20.0402	20.0527	20.0550	20.0659	20.0659	20.0680	20.0617	20.0550	20.0503	20.0453	(88)
util rest of house													
	0.9817	0.9666	0.9348	0.8604	0.7251	0.5357	0.3717	0.4185	0.6728	0.8951	0.9680	0.9850	(89)
MIT 2	17.8204	18.1664	18.6793	19.3023	19.7576	19.9968	20.0527	20.0474	19.9000	19.3047	18.4626	17.7701	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.1353	18.4590	18.9396	19.5245	19.9566	20.1868	20.2435	20.2371	20.0910	19.5245	18.7347	18.0873	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9853	18.3090	18.7896	19.3745	19.8066	20.0368	20.0935	20.0871	19.9410	19.3745	18.5847	17.9373	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9530	0.9165	0.8405	0.7119	0.5333	0.3745	0.4205	0.6635	0.8753	0.9549	0.9769	(94)
Useful gains	478.9412	552.9710	605.8505	623.1359	566.0888	417.2172	279.3600	291.6629	420.9017	484.5879	465.0844	452.8582	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1155.7565	1128.9061	1031.5038	866.5154	668.8025	442.8242	284.5416	299.5976	478.1154	723.9058	952.7392	1146.1667	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	503.5506	387.0284	316.6860	175.2333	76.4190	0.0000	0.0000	0.0000	0.0000	178.0525	351.1115	515.8215	(98)
Space heating												2503.9029	(98)
Space heating per m2											(98) / (4) =	31.3851	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2766.7435	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	503.5506	387.0284	316.6860	175.2333	76.4190	0.0000	0.0000	0.0000	0.0000	178.0525	351.1115	515.8215	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	556.4095	427.6557	349.9293	193.6279	84.4409	0.0000	0.0000	0.0000	0.0000	196.7431	387.9685	569.9685	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6880	89.6055	89.4444	89.0944	88.4692	87.3000	87.3000	87.3000	87.3000	89.0776	89.5254	89.7200	(217)
Fuel for water heating, kWh/month													
	184.1538	161.6432	168.1334	148.6278	144.7188	128.1956	120.4190	135.8687	136.8056	154.2907	165.6884	178.7634	(219)
Water heating fuel used												1827.3083	(219)
Annual totals kWh/year													
Space heating fuel - main system												2766.7435	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =												-1218.5571	(233)
Total delivered energy for all uses												3811.2877	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2766.7435	0.2160	597.6166	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1827.3083	0.2160	394.6986	(264)
Space and water heating			992.3152	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			586.0606	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.3500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		7.3500	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		25.8463	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.8463	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3361	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4286	0.4202	0.4118	0.3698	0.3614	0.3193	0.3193	0.3109	0.3361	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
GF B&B J150 P/A=0.20			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.1800	5.7474			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.9136			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6082	(36)
Total fabric heat loss (33) + (36) =	43.5218	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.2787	40.0360	39.7981	38.6806	38.4716	37.4983	37.4983	37.3181	37.8732	38.4716	38.8945	39.3367	(38)
Heat transfer coeff	83.8005	83.5578	83.3199	82.2024	81.9933	81.0201	81.0201	80.8398	81.3950	81.9933	82.4163	82.8585	(39)
Average = Sum(39)m / 12 =												82.2014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0504	1.0474	1.0444	1.0304	1.0277	1.0155	1.0155	1.0133	1.0202	1.0277	1.0330	1.0386	(40)
HLP (average)												1.0304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.9163	384.4486	370.2580	347.8101	325.0467	303.1290	289.3430	296.0006	307.8855	330.5449	356.4452	375.6922	(73)

---

6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast		7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest		5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	101.8955	179.3612	260.8037	348.9509	414.4055	421.7682	402.3184	351.9026	291.0802	202.3829	123.1027	86.5183	(83)
Total gains	488.8118	563.8098	631.0617	696.7611	739.4522	724.8972	691.6614	647.9032	598.9656	532.9278	479.5479	462.2106	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.1127	66.3048	66.4941	67.3980	67.5699	68.3816	68.3816	68.5340	68.0666	67.5699	67.2231	66.8644	
alpha	5.4075	5.4203	5.4329	5.4932	5.5047	5.5588	5.5588	5.5689	5.5378	5.5047	5.4815	5.4576	
util living area													
	0.9978	0.9948	0.9858	0.9530	0.8590	0.6797	0.5091	0.5625	0.8185	0.9704	0.9951	0.9984	(86)
MIT	19.9069	20.0590	20.2966	20.6021	20.8466	20.9689	20.9947	20.9911	20.9140	20.5960	20.1960	19.8819	(87)
Th 2	20.0415	20.0441	20.0465	20.0581	20.0603	20.0704	20.0704	20.0723	20.0665	20.0603	20.0559	20.0513	(88)
util rest of house													
	0.9971	0.9930	0.9808	0.9362	0.8125	0.5954	0.4049	0.4550	0.7464	0.9566	0.9931	0.9978	(89)
MIT 2	18.5809	18.8044	19.1504	19.5912	19.9109	20.0498	20.0684	20.0686	19.9984	19.5914	19.0138	18.5515	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8548	19.0636	19.3872	19.8000	20.1042	20.2397	20.2598	20.2591	20.1875	19.7989	19.2580	18.8263	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8548	19.0636	19.3872	19.8000	20.1042	20.2397	20.2598	20.2591	20.1875	19.7989	19.2580	18.8263	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9905	0.9763	0.9306	0.8149	0.6115	0.4265	0.4772	0.7569	0.9516	0.9907	0.9968	(94)
Useful gains	486.7197	558.4596	616.0780	648.3956	602.5877	443.2781	294.9797	309.1862	453.3514	507.1221	475.1081	460.7233	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1219.7023	1183.4786	1073.7571	896.0061	689.0884	456.9267	296.5136	311.9716	495.4958	754.2493	1002.0179	1211.9150	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	545.3391	420.0128	340.5132	178.2796	64.3565	0.0000	0.0000	0.0000	0.0000	183.8626	379.3751	558.8866	(98)
Space heating												2670.6255	(98)
Space heating per m2											(98) / (4) =	33.4749	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2859.3421	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	545.3391	420.0128	340.5132	178.2796	64.3565	0.0000	0.0000	0.0000	0.0000	183.8626	379.3751	558.8866	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	583.8749	449.6925	364.5752	190.8775	68.9042	0.0000	0.0000	0.0000	0.0000	196.8551	406.1832	598.3797	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.4277	87.1467	86.5740	85.2679	82.9785	80.3000	80.3000	80.3000	80.3000	85.2262	86.8442	87.5282	(217)
Fuel for water heating, kWh/month													
	231.0524	203.4275	213.0530	191.8620	190.8811	173.7253	166.4421	185.5439	187.5930	201.2650	210.8436	225.3419	(219)
Water heating fuel used												2381.0309	(219)
Annual totals kWh/year													
Space heating fuel - main system												2859.3421	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Total delivered energy for all uses												5676.1659	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2859.3421	0.2160	617.6179	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2381.0309	0.2160	514.3027	(264)
Space and water heating			1131.9206	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Total CO2, kg/m2/year			1358.0971	(272)
Emissions per m2 for space and water heating			14.1880	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3471	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1880 * 1.00) + 2.3471 + 0.4879, rounded to 2 d.p.			17.0200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.3400	
Infiltration rate			0.3625	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3081	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3928	0.3851	0.3774	0.3389	0.3312	0.2927	0.2927	0.2850	0.3081	0.3312	0.3466	0.3620	(22b)
Effective ac	0.5772	0.5742	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5475	0.5548	0.5601	0.5655	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11739.4690	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.1480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2203	(36)
Total fabric heat loss	(33) + (36) = 43.6742	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.2791	39.0752	38.8753	37.9366	37.7609	36.9433	36.9433	36.7919	37.2583	37.7609	38.1163	38.4877	(38)
Heat transfer coeff	82.9533	82.7494	82.5496	81.6108	81.4352	80.6176	80.6176	80.4662	80.9325	81.4352	81.7905	82.1620	(39)
Average = Sum(39)m / 12 =												81.6100	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0398	1.0372	1.0347	1.0229	1.0207	1.0105	1.0105	1.0086	1.0144	1.0207	1.0252	1.0299	(40)
HLP (average)												1.0229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.4310	341.0521	329.0988	309.4643	288.7499	269.4586	257.3659	261.2197	271.6995	291.4691	314.1883	331.9756	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	460.5260	548.9285	631.3656	713.8922	769.0385	758.2804	723.6457	669.0685	609.0562	526.0273	456.8621	432.2488	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, n1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.3108	39.4077	39.5031	39.9575	40.0437	40.4498	40.4498	40.5259	40.2924	40.0437	39.8697	39.6895	
alpha	3.6207	3.6272	3.6335	3.6638	3.6696	3.6967	3.6967	3.7017	3.6862	3.6696	3.6580	3.6460	
util living area													
	0.9875	0.9760	0.9512	0.8918	0.7798	0.6178	0.4716	0.5238	0.7512	0.9260	0.9784	0.9900	(86)
MIT	19.3268	19.5668	19.9261	20.3661	20.7150	20.9139	20.9756	20.9643	20.8173	20.3496	19.7544	19.2828	(87)
Th 2	20.0503	20.0524	20.0545	20.0643	20.0661	20.0746	20.0746	20.0762	20.0713	20.0661	20.0624	20.0585	(88)
util rest of house													
	0.9850	0.9713	0.9414	0.8697	0.7359	0.5463	0.3799	0.4298	0.6879	0.9061	0.9733	0.9880	(89)
MIT 2	18.5167	18.7556	19.1100	19.5399	19.8576	20.0255	20.0652	20.0613	19.9549	19.5342	18.9511	18.4792	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.6841	18.9232	19.2786	19.7105	20.0347	20.2090	20.2532	20.2478	20.1330	19.7026	19.1170	18.6452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6841	18.9232	19.2786	19.7105	20.0347	20.2090	20.2532	20.2478	20.1330	19.7026	19.1170	18.6452	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9802	0.9640	0.9315	0.8600	0.7343	0.5573	0.3982	0.4480	0.6926	0.8967	0.9666	0.9839	(94)
Useful gains	451.4102	529.1624	588.0928	613.9553	564.7024	422.5707	288.1277	299.7548	421.8111	471.6952	441.5991	425.2711	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1193.2059	1160.4117	1054.8651	882.2568	678.7370	452.1850	294.5155	309.6172	488.2695	741.2741	982.8799	1186.8446	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	551.8960	424.1996	347.2786	193.1771	84.8417	0.0000	0.0000	0.0000	0.0000	200.5667	389.7222	566.6108	(98)
Space heating												2758.2926	(98)
Space heating per m2											(98) / (4) =	34.5737	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	757.8052	596.5700	611.5428	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8745	0.9220	0.9015	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	662.7062	550.0293	551.3216	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	978.3362	935.9885	873.8535	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	227.2536	287.1537	239.9637	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												754.3710 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	56.8134	71.7884	59.9909	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												188.5928 (107)
Space cooling per m2												2.3639 (108)
Energy for space heating												34.5737 (99)
Energy for space cooling												2.3639 (108)
Total												36.9376 (109)
Dwelling Fabric Energy Efficiency (DFEE)												36.9 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3361	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4286	0.4202	0.4118	0.3698	0.3614	0.3193	0.3193	0.3109	0.3361	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
GF B&B J150 P/A=0.20			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.1800	5.7474			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.9136			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6082	(36)
Total fabric heat loss (33) + (36) =	43.5218	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.2787	40.0360	39.7981	38.6806	38.4716	37.4983	37.4983	37.3181	37.8732	38.4716	38.8945	39.3367	(38)
Heat transfer coeff	83.8005	83.5578	83.3199	82.2024	81.9933	81.0201	81.0201	80.8398	81.3950	81.9933	82.4163	82.8585	(39)
Average = Sum(39)m / 12 =												82.2014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0504	1.0474	1.0444	1.0304	1.0277	1.0155	1.0155	1.0133	1.0202	1.0277	1.0330	1.0386	(40)
HLP (average)												1.0304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.4310	341.0521	329.0988	309.4643	288.7499	269.4586	257.3659	261.2197	271.6995	291.4691	314.1883	331.9756	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	101.8955	179.3612	260.8037	348.9509	414.4055	421.7682	402.3184	351.9026	291.0802	202.3829	123.1027	86.5183	(83)
Total gains	444.3264	520.4133	589.9024	658.4152	703.1554	691.2268	659.6843	613.1223	562.7797	493.8520	437.2910	418.4939	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.1127	66.3048	66.4941	67.3980	67.5699	68.3816	68.3816	68.5340	68.0666	67.5699	67.2231	66.8644	
alpha	5.4075	5.4203	5.4329	5.4932	5.5047	5.5588	5.5588	5.5689	5.5378	5.5047	5.4815	5.4576	
util living area													
	0.9986	0.9964	0.9895	0.9624	0.8784	0.7055	0.5321	0.5912	0.8462	0.9786	0.9968	0.9990	(86)
MIT	19.8541	20.0082	20.2505	20.5655	20.8256	20.9627	20.9934	20.9887	20.8970	20.5552	20.1464	19.8297	(87)
Th 2	20.0415	20.0441	20.0465	20.0581	20.0603	20.0704	20.0704	20.0723	20.0665	20.0603	20.0559	20.0513	(88)
util rest of house													
	0.9982	0.9952	0.9857	0.9483	0.8353	0.6206	0.4241	0.4798	0.7784	0.9680	0.9956	0.9987	(89)
MIT 2	18.9917	19.1474	19.3897	19.7057	19.9421	20.0532	20.0687	20.0690	20.0091	19.7020	19.2952	18.9753	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.1699	19.3252	19.5675	19.8833	20.1246	20.2411	20.2597	20.2590	20.1925	19.8782	19.4710	19.1518	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1699	19.3252	19.5675	19.8833	20.1246	20.2411	20.2597	20.2590	20.1925	19.8782	19.4710	19.1518	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9940	0.9833	0.9451	0.8386	0.6371	0.4466	0.5029	0.7888	0.9654	0.9945	0.9982	(94)
Useful gains	443.2425	517.2819	580.0327	622.3009	589.6941	440.4097	294.5846	308.3583	443.9248	476.7625	434.8699	417.7515	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1246.1009	1205.3377	1088.7843	902.8560	690.7612	457.0433	296.5102	311.9584	495.9028	760.7508	1019.5743	1238.8848	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	597.3267	462.3735	378.5112	201.9997	75.1939	0.0000	0.0000	0.0000	0.0000	211.2873	420.9871	610.9232	(98)
Space heating												2958.6026	(98)
Space heating per m2											(98) / (4) =	37.0845	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	761.5886	599.5485	614.3827	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9087	0.9553	0.9377	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	692.0215	572.7263	576.0989	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	899.9618	861.2284	808.4618	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	149.7170	214.6455	172.8780	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												537.2406	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Intermittency factor (Table 10b)
          0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
          0.0000    0.0000    0.0000    0.0000    0.0000   37.4293   53.6614   43.2195    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                            134.3101 (107)
Space cooling per m2                                                                                                       1.6835 (108)
Energy for space heating                                                                                                  37.0845 (99)
Energy for space cooling                                                                                                   1.6835 (108)
Total                                                                                                                     38.7680 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                       44.6 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.3400	
Infiltration rate			0.4110	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3668	0.3406	0.3493	0.3318	0.3318	0.3231	0.3144	0.3056	0.2969	0.3231	0.3056	0.3231	(22b)
Effective ac	0.5673	0.5580	0.5610	0.5551	0.5551	0.5522	0.5494	0.5467	0.5441	0.5522	0.5467	0.5522	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6059	37.9753	38.1803	37.7754	37.7754	37.5808	37.3914	37.2071	37.0281	37.5808	37.2071	37.5808	(38)
Heat transfer coeff	82.2801	81.6495	81.8545	81.4497	81.4497	81.2551	81.0656	80.8814	80.7023	81.2551	80.8814	81.2551	(39)
Average = Sum(39)m / 12 =												81.3316	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0313	1.0234	1.0260	1.0209	1.0209	1.0185	1.0161	1.0138	1.0116	1.0185	1.0138	1.0185	(40)
HLP (average)												1.0194	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	146.3734	219.8549	324.0412	439.2794	498.0895	551.5262	521.6404	465.9832	383.0511	268.1334	176.3738	122.1086	(83)
Total gains	700.9151	769.9327	852.6474	934.6764	959.5370	982.6039	935.0178	887.7033	823.9317	742.4348	687.7679	661.5152	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.6325	39.9386	39.8385	40.0365	40.0365	40.1324	40.2262	40.3179	40.4073	40.1324	40.3179	40.1324	
alpha	3.6422	3.6626	3.6559	3.6691	3.6691	3.6755	3.6817	3.6879	3.6938	3.6755	3.6879	3.6755	
util living area													
	0.9511	0.9320	0.8838	0.7867	0.6440	0.4552	0.3340	0.3503	0.5728	0.8051	0.9179	0.9572	(86)
MIT	19.8140	19.9806	20.2918	20.6360	20.8655	20.9712	20.9930	20.9918	20.9338	20.6702	20.2244	19.7937	(87)
Th 2	20.0573	20.0639	20.0617	20.0659	20.0659	20.0680	20.0699	20.0718	20.0737	20.0680	20.0718	20.0680	(88)
util rest of house													
	0.9423	0.9202	0.8640	0.7523	0.5904	0.3864	0.2562	0.2692	0.5018	0.7649	0.9013	0.9493	(89)
MIT 2	18.5087	18.7490	19.1829	19.6490	19.9343	20.0474	20.0667	20.0681	20.0201	19.7066	19.1048	18.4880	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.7783	19.0034	19.4119	19.8529	20.1267	20.2382	20.2580	20.2589	20.2089	19.9056	19.3360	18.7578	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6283	18.8534	19.2619	19.7029	19.9767	20.0882	20.1080	20.1089	20.0589	19.7556	19.1860	18.6078	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9251	0.9012	0.8442	0.7374	0.5850	0.3879	0.2594	0.2725	0.5007	0.7497	0.8819	0.9331	(94)
Useful gains	648.4082	693.8834	719.7906	689.2667	561.3127	381.1598	242.5678	241.8657	412.5056	556.5801	606.5235	617.2872	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1129.5663	1106.6324	1003.6952	831.0230	608.9717	389.0663	243.8492	243.3636	432.4741	678.9387	912.8300	1105.6990	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	357.9816	277.3673	211.2250	102.0645	35.4583	0.0000	0.0000	0.0000	0.0000	91.0348	220.5407	363.3784	(98)
Space heating												1659.0507	(98)
RHI space heating demand												1659	(98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.3400	
Infiltration rate			0.4110	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4454	0.4366	0.4279	0.3842	0.3755	0.3318	0.3318	0.3231	0.3493	0.3755	0.3930	0.4104	(22b)
Effective ac	0.5992	0.5953	0.5916	0.5738	0.5705	0.5551	0.5551	0.5522	0.5610	0.5705	0.5772	0.5842	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7779	40.5158	40.2589	39.0522	38.8264	37.7754	37.7754	37.5808	38.1803	38.8264	39.2832	39.7607	(38)
Heat transfer coeff	84.4522	84.1901	83.9332	82.7265	82.5007	81.4497	81.4497	81.2551	81.8545	82.5007	82.9574	83.4349	(39)
Average = Sum(39)m / 12 =												82.7254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0586	1.0553	1.0521	1.0369	1.0341	1.0209	1.0209	1.0185	1.0260	1.0341	1.0398	1.0458	(40)
HLP (average)												1.0369	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	672.6367	757.9542	830.8731	899.8248	941.7360	919.8995	879.6573	829.5690	778.2374	708.8596	654.0679	639.6798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6131	38.7333	38.8519	39.4186	39.5265	40.0365	40.0365	40.1324	39.8385	39.5265	39.3089	39.0839	
alpha	3.5742	3.5822	3.5901	3.6279	3.6351	3.6691	3.6691	3.6755	3.6559	3.6351	3.6206	3.6056	
util living area													
	0.9616	0.9409	0.9025	0.8236	0.6978	0.5338	0.3983	0.4370	0.6462	0.8522	0.9401	0.9670	(86)
MIT	19.6342	19.8501	20.1628	20.5323	20.8018	20.9453	20.9855	20.9797	20.8883	20.5427	20.0322	19.5942	(87)
Th 2	20.0348	20.0375	20.0402	20.0527	20.0550	20.0659	20.0659	20.0680	20.0617	20.0550	20.0503	20.0453	(88)
util rest of house													
	0.9547	0.9306	0.8854	0.7936	0.6494	0.4659	0.3175	0.3539	0.5791	0.8201	0.9278	0.9610	(89)
MIT 2	18.2358	18.5452	18.9883	19.5031	19.8500	20.0220	20.0580	20.0561	19.9632	19.5309	18.8192	18.1856	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5246	18.8148	19.2309	19.7157	20.0466	20.2128	20.2496	20.2469	20.1543	19.7399	19.0698	18.4766	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3746	18.6648	19.0809	19.5657	19.8966	20.0628	20.0996	20.0969	20.0043	19.5899	18.9198	18.3266	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9387	0.9118	0.8649	0.7762	0.6406	0.4657	0.3205	0.3565	0.5747	0.8016	0.9091	0.9463	(94)
Useful gains	631.4308	691.1019	718.6276	698.4100	603.3221	428.3928	281.9442	295.7701	447.2780	568.2468	594.6419	605.3261	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1188.6345	1158.8576	1055.9572	882.3377	676.2250	444.9394	285.0447	300.3908	483.2902	741.6718	980.5398	1178.6495	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	414.5596	314.3318	250.9733	132.4280	54.2398	0.0000	0.0000	0.0000	0.0000	129.0282	277.8464	426.5526	(98)
Space heating												1999.9596	(98)
Space heating per m2											(98) / (4) =	25.0684	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2209.9002	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	414.5596	314.3318	250.9733	132.4280	54.2398	0.0000	0.0000	0.0000	0.0000	129.0282	277.8464	426.5526	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	458.0769	347.3280	277.3185	146.3292	59.9335	0.0000	0.0000	0.0000	0.0000	142.5726	307.0126	471.3288	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5647	89.4656	89.2739	88.8713	88.2283	87.3000	87.3000	87.3000	87.3000	88.8207	89.3599	89.6025	(217)
Fuel for water heating, kWh/month													
	184.4074	161.8961	168.4545	149.0009	145.1139	128.1956	120.4190	135.8687	136.8056	154.7369	165.9952	178.9978	(219)
Water heating fuel used												1829.8915	(219)
Annual totals kWh/year													
Space heating fuel - main system												2209.9002	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3257.0275	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2209.9002	3.4800	76.9045	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.8915	3.4800	63.6802	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	360.7929	13.1900	47.5886	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			157.3382	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5296	(257)
SAP value		92.6122	
SAP rating (Section 12)		93	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2209.9002	0.2160	477.3384	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.8915	0.2160	395.2566	(264)
Space and water heating			872.5950	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			466.3404	(272)
CO2 emissions per m2			5.8500	(273)
EI value			94.9920	
EI rating			95	(274)
EI band			A	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8853 = 3.931, stars = 4
Water heating environmental impact	0.216 / 0.8853 = 0.2440, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.3400	
Infiltration rate		0.4110	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3668	0.3406	0.3493	0.3318	0.3318	0.3231	0.3144	0.3056	0.2969	0.3231	0.3056	0.3231	(22b)
Effective ac	0.5673	0.5580	0.5610	0.5551	0.5551	0.5522	0.5494	0.5467	0.5441	0.5522	0.5467	0.5522	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6059	37.9753	38.1803	37.7754	37.7754	37.5808	37.3914	37.2071	37.0281	37.5808	37.2071	37.5808	(38)
Heat transfer coeff	82.2801	81.6495	81.8545	81.4497	81.4497	81.2551	81.0656	80.8814	80.7023	81.2551	80.8814	81.2551	(39)
Average = Sum(39)m / 12 =												81.3316	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0313	1.0234	1.0260	1.0209	1.0209	1.0185	1.0161	1.0138	1.0116	1.0185	1.0138	1.0185	(40)
HLP (average)												1.0194	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	146.3734	219.8549	324.0412	439.2794	498.0895	551.5262	521.6404	465.9832	383.0511	268.1334	176.3738	122.1086	(83)
Total gains	700.9151	769.9327	852.6474	934.6764	959.5370	982.6039	935.0178	887.7033	823.9317	742.4348	687.7679	661.5152	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.6325	39.9386	39.8385	40.0365	40.0365	40.1324	40.2262	40.3179	40.4073	40.1324	40.3179	40.1324	
alpha	3.6422	3.6626	3.6559	3.6691	3.6691	3.6755	3.6817	3.6879	3.6938	3.6755	3.6879	3.6755	
util living area													
	0.9511	0.9320	0.8838	0.7867	0.6440	0.4552	0.3340	0.3503	0.5728	0.8051	0.9179	0.9572	(86)
MIT	19.8140	19.9806	20.2918	20.6360	20.8655	20.9712	20.9930	20.9918	20.9338	20.6702	20.2244	19.7937	(87)
Th 2	20.0573	20.0639	20.0617	20.0659	20.0659	20.0680	20.0699	20.0718	20.0737	20.0680	20.0718	20.0680	(88)
util rest of house													
	0.9423	0.9202	0.8640	0.7523	0.5904	0.3864	0.2562	0.2692	0.5018	0.7649	0.9013	0.9493	(89)
MIT 2	18.5087	18.7490	19.1829	19.6490	19.9343	20.0474	20.0667	20.0681	20.0201	19.7066	19.1048	18.4880	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.7783	19.0034	19.4119	19.8529	20.1267	20.2382	20.2580	20.2589	20.2089	19.9056	19.3360	18.7578	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6283	18.8534	19.2619	19.7029	19.9767	20.0882	20.1080	20.1089	20.0589	19.7556	19.1860	18.6078	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9251	0.9012	0.8442	0.7374	0.5850	0.3879	0.2594	0.2725	0.5007	0.7497	0.8819	0.9331	(94)
Useful gains	648.4082	693.8834	719.7906	689.2667	561.3127	381.1598	242.5678	241.8657	412.5056	556.5801	606.5235	617.2872	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1129.5663	1106.6324	1003.6952	831.0230	608.9717	389.0663	243.8492	243.3636	432.4741	678.9387	912.8300	1105.6990	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	357.9816	277.3673	211.2250	102.0645	35.4583	0.0000	0.0000	0.0000	0.0000	91.0348	220.5407	363.3784	(98)
Space heating												1659.0507	(98)
Space heating per m2											(98) / (4) =	20.7953	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1833.2052	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	357.9816	277.3673	211.2250	102.0645	35.4583	0.0000	0.0000	0.0000	0.0000	91.0348	220.5407	363.3784	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	395.5598	306.4832	233.3978	112.7785	39.1805	0.0000	0.0000	0.0000	0.0000	100.5910	243.6914	401.5231	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.4647	89.3761	89.1411	88.6646	87.9747	87.3000	87.3000	87.3000	87.3000	88.5475	89.1854	89.4955	(217)
Fuel for water heating, kWh/month													
	184.6135	162.0581	168.7054	149.3481	145.5324	128.1956	120.4190	135.8687	136.8056	155.2143	166.3200	179.2119	(219)
Water heating fuel used												1832.2926	(219)
Annual totals kWh/year													
Space heating fuel - main system												1833.2052	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =											-1368.9771	-1368.9771	(233)
Total delivered energy for all uses												2732.3136	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1833.2052	10.2300	187.5369	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1832.2926	10.2300	187.4435	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	360.7929	36.7200	132.4832	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			135.3152	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1833.2052	0.2160	395.9723	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.2926	0.2160	395.7752	(264)
Space and water heating			791.7475	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			307.4249	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1833.2052	1.2200	2236.5103	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.2926	1.2200	2235.3969	(264)
Space and water heating			4471.9073	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	360.7929	3.0700	1107.6343	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1607.0318	(272)
Primary energy kWh/m2/year			20.1433	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 93
Current environmental impact rating: A 95

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 82	-185 kg (60.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£82	2.32 kg/m²	A 94	A 97
Total Savings	£82	2.32 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£160	£178	-£18
Mains gas	£478	£378	£100
Space heating	£318	£318	£0
Water heating	£187	£106	£82
Lighting	£132	£132	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£135	£53	£82
Total cost of uses	£134	£53	£82
Delivered energy	34 kWh/m²	23 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.3 tonnes	0.1 tonnes	0.2 tonnes
CO2 emissions per m²	4 kg/m²	2 kg/m²	2 kg/m²
Primary energy	20 kWh/m²	7 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.3400	
Infiltration rate			0.4110	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4454	0.4366	0.4279	0.3842	0.3755	0.3318	0.3318	0.3231	0.3493	0.3755	0.3930	0.4104	(22b)
Effective ac	0.5992	0.5953	0.5916	0.5738	0.5705	0.5551	0.5551	0.5522	0.5610	0.5705	0.5772	0.5842	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7779	40.5158	40.2589	39.0522	38.8264	37.7754	37.7754	37.5808	38.1803	38.8264	39.2832	39.7607	(38)
Heat transfer coeff	84.4522	84.1901	83.9332	82.7265	82.5007	81.4497	81.4497	81.2551	81.8545	82.5007	82.9574	83.4349	(39)
Average = Sum(39)m / 12 =												82.7254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0586	1.0553	1.0521	1.0369	1.0341	1.0209	1.0209	1.0185	1.0260	1.0341	1.0398	1.0458	(40)
HLP (average)												1.0369	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)

Combi loss

14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input

-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)

Solar input (sum of months) = Sum(63)m = -843.3953 (63)

Output from w/h

140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)

Heat gains from water heating, kWh/month

53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)

Pumps, fans

3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)

Water heating gains (Table 5)

72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)

Total internal gains

554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains

118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)

Total gains

672.6367	757.9542	830.8731	899.8248	941.7360	919.8995	879.6573	829.5690	778.2374	708.8596	654.0679	639.6798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6131	38.7333	38.8519	39.4186	39.5265	40.0365	40.0365	40.1324	39.8385	39.5265	39.3089	39.0839	
alpha	3.5742	3.5822	3.5901	3.6279	3.6351	3.6691	3.6691	3.6755	3.6559	3.6351	3.6206	3.6056	
util living area	0.9616	0.9409	0.9025	0.8236	0.6978	0.5338	0.3983	0.4370	0.6462	0.8522	0.9401	0.9670	(86)
MIT	19.6342	19.8501	20.1628	20.5323	20.8018	20.9453	20.9855	20.9797	20.8883	20.5427	20.0322	19.5942	(87)
Th 2	20.0348	20.0375	20.0402	20.0527	20.0550	20.0659	20.0659	20.0680	20.0617	20.0550	20.0503	20.0453	(88)
util rest of house	0.9547	0.9306	0.8854	0.7936	0.6494	0.4659	0.3175	0.3539	0.5791	0.8201	0.9278	0.9610	(89)
MIT 2	18.2358	18.5452	18.9883	19.5031	19.8500	20.0220	20.0580	20.0561	19.9632	19.5309	18.8192	18.1856	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.5246	18.8148	19.2309	19.7157	20.0466	20.2128	20.2496	20.2469	20.1543	19.7399	19.0698	18.4766	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3746	18.6648	19.0809	19.5657	19.8966	20.0628	20.0996	20.0969	20.0043	19.5899	18.9198	18.3266	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9387	0.9118	0.8649	0.7762	0.6406	0.4657	0.3205	0.3565	0.5747	0.8016	0.9091	0.9463	(94)
Useful gains	631.4308	691.1019	718.6276	698.4100	603.3221	428.3928	281.9442	295.7701	447.2780	568.2468	594.6419	605.3261	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1188.6345	1158.8576	1055.9572	882.3377	676.2250	444.9394	285.0447	300.3908	483.2902	741.6718	980.5398	1178.6495	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	414.5596	314.3318	250.9733	132.4280	54.2398	0.0000	0.0000	0.0000	0.0000	129.0282	277.8464	426.5526	(98)
Space heating												1999.9596	(98)
Space heating per m2											(98) / (4) =	25.0684	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2209.9002	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	414.5596	314.3318	250.9733	132.4280	54.2398	0.0000	0.0000	0.0000	0.0000	129.0282	277.8464	426.5526	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	458.0769	347.3280	277.3185	146.3292	59.9335	0.0000	0.0000	0.0000	0.0000	142.5726	307.0126	471.3288	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6671	89.6826	89.6987	89.7476	89.8651	87.3000	87.3000	87.3000	87.3000	89.1990	89.5142	89.6880	(217)
Fuel for water heating, kWh/month	156.9216	115.9979	90.1680	43.7524	14.4103	0.0000	0.0000	24.1300	49.2919	95.5913	133.3017	156.0079	(219)
Water heating fuel used												879.5730	(219)
Annual totals kWh/year													
Space heating fuel - main system												2209.9002	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												2356.7091	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2209.9002	3.4800	76.9045	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	879.5730	3.4800	30.6091	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	360.7929	13.1900	47.5886	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			130.8621	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4405	(257)
SAP value	93.8554	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2209.9002	0.2160	477.3384	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	879.5730	0.2160	189.9878	(264)
Space and water heating			667.3262	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			287.0216	(272)
CO2 emissions per m2			3.6000	(273)
EI value			96.9177	
EI rating			97	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.3400	
Infiltration rate			0.4110	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3493	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3668	0.3406	0.3493	0.3318	0.3318	0.3231	0.3144	0.3056	0.2969	0.3231	0.3056	0.3231	(22b)
Effective ac	0.5673	0.5580	0.5610	0.5551	0.5551	0.5522	0.5494	0.5467	0.5441	0.5522	0.5467	0.5522	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6059	37.9753	38.1803	37.7754	37.7754	37.5808	37.3914	37.2071	37.0281	37.5808	37.2071	37.5808	(38)
Heat transfer coeff	82.2801	81.6495	81.8545	81.4497	81.4497	81.2551	81.0656	80.8814	80.7023	81.2551	80.8814	81.2551	(39)
Average = Sum(39)m / 12 =												81.3316	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0313	1.0234	1.0260	1.0209	1.0209	1.0185	1.0161	1.0138	1.0116	1.0185	1.0138	1.0185	(40)
HLP (average)												1.0194	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
               22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3932 (H8)
Utilisation factor                                                                                                                  0.5122 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -875.5295 (H17)
Solar input    -28.5619   -40.6132   -69.8043   -94.1822  -110.6226  -118.1624  -115.6775  -103.5348   -81.0606   -56.0425   -33.7812   -23.4862 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -875.5295 (63)
Output from w/h
              136.6020   104.2280    80.5815    38.2368    17.4090     0.0000     0.0000    15.0785    38.3707    81.3959   114.5520   136.9003 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    763.3548 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               51.0740    45.3635    36.8920    27.9296    20.8777    17.6259    19.0454    24.7559    33.2273    42.1897    49.2416    52.4935 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              554.5417   550.0778   528.6063   495.3969   461.4475   431.0777   413.3774   421.7201   440.8806   474.3014   511.3941   539.4066 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                          m2         Table 6a     Specific data  Specific data      factor               W
                                                        W/m2     or Table 6b    or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
Southeast                                3.0000          45.1778         0.4600         0.0000       0.7700        48.0060 (77)
Northwest                                5.0600          14.6176         0.4600         0.0000       0.7700        26.1985 (81)
Southeast                                4.5100          45.1778         0.4600         0.0000       0.7700        72.1690 (77)
-------------------------------------------------------------------------------------------------------------

Solar gains    146.3734   219.8549   324.0412   439.2794   498.0895   551.5262   521.6404   465.9832   383.0511   268.1334   176.3738   122.1086 (83)
Total gains    700.9151   769.9327   852.6474   934.6764   959.5370   982.6039   935.0178   887.7033   823.9317   742.4348   687.7679   661.5152 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            39.6325    39.9386    39.8385    40.0365    40.0365    40.1324    40.2262    40.3179    40.4073    40.1324    40.3179    40.1324
alpha           3.6422     3.6626     3.6559     3.6691     3.6691     3.6755     3.6817     3.6879     3.6938     3.6755     3.6879     3.6755
util living area
                0.9511     0.9320     0.8838     0.7867     0.6440     0.4552     0.3340     0.3503     0.5728     0.8051     0.9179     0.9572 (86)

MIT            19.8140    19.9806    20.2918    20.6360    20.8655    20.9712    20.9930    20.9918    20.9338    20.6702    20.2244    19.7937 (87)
Th 2           20.0573    20.0639    20.0617    20.0659    20.0659    20.0680    20.0699    20.0718    20.0737    20.0680    20.0718    20.0680 (88)
util rest of house
                0.9423     0.9202     0.8640     0.7523     0.5904     0.3864     0.2562     0.2692     0.5018     0.7649     0.9013     0.9493 (89)
MIT 2          18.5087    18.7490    19.1829    19.6490    19.9343    20.0474    20.0667    20.0681    20.0201    19.7066    19.1048    18.4880 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT            18.7783    19.0034    19.4119    19.8529    20.1267    20.2382    20.2580    20.2589    20.2089    19.9056    19.3360    18.7578 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   18.6283    18.8534    19.2619    19.7029    19.9767    20.0882    20.1080    20.1089    20.0589    19.7556    19.1860    18.6078 (93)
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9251	0.9012	0.8442	0.7374	0.5850	0.3879	0.2594	0.2725	0.5007	0.7497	0.8819	0.9331	(94)
Useful gains	648.4082	693.8834	719.7906	689.2667	561.3127	381.1598	242.5678	241.8657	412.5056	556.5801	606.5235	617.2872	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1129.5663	1106.6324	1003.6952	831.0230	608.9717	389.0663	243.8492	243.3636	432.4741	678.9387	912.8300	1105.6990	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	357.9816	277.3673	211.2250	102.0645	35.4583	0.0000	0.0000	0.0000	0.0000	91.0348	220.5407	363.3784	(98)

Space heating 1659.0507 (98)
Space heating per m2 (98) / (4) = 20.7953 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1833.2052 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	357.9816	277.3673	211.2250	102.0645	35.4583	0.0000	0.0000	0.0000	0.0000	91.0348	220.5407	363.3784	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	395.5598	306.4832	233.3978	112.7785	39.1805	0.0000	0.0000	0.0000	0.0000	100.5910	243.6914	401.5231	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater	89.5930	89.6029	89.5931	89.6049	89.4207	87.3000	87.3000	87.3000	87.3000	88.9607	89.3800	87.3000	(216)
(217)m	152.4696	116.3222	89.9417	42.6727	19.4686	0.0000	0.0000	17.2721	43.9527	91.4965	128.1629	89.6012	(217)
Fuel for water heating, kWh/month												152.7884	(219)

Water heating fuel used 854.5472 (219)
Annual totals kWh/year
Space heating fuel - main system 1833.2052 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 360.7929 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771 -1368.9771 (233)
Total delivered energy for all uses 1804.5682 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1833.2052	10.2300	187.5369	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	854.5472	10.2300	87.4202	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	360.7929	36.7200	132.4832	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			53.6518	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1833.2052	0.2160	395.9723	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	854.5472	0.2160	184.5822	(264)
Space and water heating			580.5545	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Total kg/year 122.1819 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1833.2052	1.2200	2236.5103	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	854.5472	1.2200	1042.5476	(264)
Space and water heating			3279.0579	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	360.7929	3.0700	1107.6343	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			567.6825	(272)
Primary energy kWh/m2/year			7.1156	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		272.23 (P1)
Transmission heat loss coefficient		43.67 (37)
Summer heat loss coefficient		315.90 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						579.9204

	Jun	Jul	Aug	
Solar gains	615	580	517	(P4)
Internal gains	428	410	419	
Total summer gains	1043	990	936	(P5)
Summer gain/loss ratio	3.30	3.13	2.96	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.27	22.00	21.73	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-340	**Issued on Date**	18/09/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-Opp-END
Property	16, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	92 A	**DER**	9.17	**TER**	18.58
Environmental	93 A	**% DER<TER**	50.66		
CO_2 Emissions (t/year)	0.43	**DFEE**	45.34	**TFEE**	52.95
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.36		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

End-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.17 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.54 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 0.72 m², No overhang
Windows facing South East: 7.51 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.5400	
Infiltration rate		0.4210	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4965	0.4867	0.4770	0.4283	0.4186	0.3699	0.3699	0.3602	0.3894	0.4186	0.4381	0.4575	(22b)
Effective ac	0.6232	0.6185	0.6138	0.5917	0.5876	0.5684	0.5684	0.5649	0.5758	0.5876	0.5959	0.6047	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4154	42.0897	41.7705	40.2710	39.9905	38.6845	38.6845	38.4427	39.1875	39.9905	40.5580	41.1513	(38)
Heat transfer coeff	98.2970	97.9713	97.6521	96.1526	95.8721	94.5661	94.5661	94.3243	95.0692	95.8721	96.4396	97.0330	(39)
Average = Sum(39)m / 12 =												96.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2321	1.2280	1.2240	1.2052	1.2017	1.1853	1.1853	1.1823	1.1916	1.2017	1.2088	1.2163	(40)
HLP (average)												1.2052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	495.2901	585.9189	671.4729	758.6227	818.3397	807.1316	769.1881	712.0567	647.1223	560.6237	490.4540	465.7066	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0061	34.1191	34.2306	34.7644	34.8662	35.3477	35.3477	35.4383	35.1606	34.8662	34.6610	34.4490	
alpha	3.2671	3.2746	3.2820	3.3176	3.3244	3.3565	3.3565	3.3626	3.3440	3.3244	3.3107	3.2966	
util living area													
	0.9860	0.9751	0.9526	0.9000	0.8006	0.6500	0.5070	0.5585	0.7750	0.9296	0.9770	0.9885	(86)
MIT	19.0645	19.3097	19.6943	20.1876	20.5999	20.8631	20.9557	20.9384	20.7380	20.1949	19.5455	19.0285	(87)
Th 2	19.8944	19.8977	19.9008	19.9158	19.9186	19.9317	19.9317	19.9342	19.9267	19.9186	19.9130	19.9070	(88)
util rest of house													
	0.9830	0.9698	0.9422	0.8772	0.7540	0.5692	0.3973	0.4480	0.7068	0.9087	0.9712	0.9860	(89)
MIT 2	17.3230	17.6801	18.2357	18.9410	19.4951	19.8203	19.9081	19.8985	19.6868	18.9673	18.0349	17.2784	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6828	18.0168	18.5370	19.1985	19.7234	20.0357	20.1245	20.1133	19.9039	19.2209	18.3469	17.6399	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5328	17.8668	18.3870	19.0485	19.5734	19.8857	19.9745	19.9633	19.7539	19.0709	18.1969	17.4899	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9556	0.9227	0.8543	0.7368	0.5654	0.4019	0.4513	0.6940	0.8869	0.9576	0.9775	(94)
Useful gains	481.9905	559.9253	619.5390	648.1182	602.9469	456.3579	309.1556	321.3306	449.0708	497.2107	469.6672	455.2152	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1300.7402	1270.3699	1160.7876	975.8076	754.8356	499.8511	319.1149	336.1048	537.5130	812.1185	1070.1854	1289.5569	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	609.1498	477.4188	402.6890	235.9363	113.0052	0.0000	0.0000	0.0000	0.0000	234.2914	432.3731	620.7503	(98)
Space heating												3125.6140	(98)
Space heating per m2											(98) / (4) =	39.1779	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3453.7171	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	609.1498	477.4188	402.6890	235.9363	113.0052	0.0000	0.0000	0.0000	0.0000	234.2914	432.3731	620.7503	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	673.0937	527.5346	444.9602	260.7031	124.8676	0.0000	0.0000	0.0000	0.0000	258.8856	477.7604	685.9119	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7979	89.7344	89.6069	89.3230	88.7716	87.3000	87.3000	87.3000	87.3000	89.2899	89.6605	89.8240	(217)
Fuel for water heating, kWh/month													
	183.9285	161.4111	167.8284	148.2474	144.2259	128.1956	120.4190	135.8687	136.8056	153.9238	165.4387	178.5564	(219)
Water heating fuel used												1824.8491	(219)
Annual totals kWh/year													
Space heating fuel - main system												3453.7171	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												4491.9217	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3453.7171	0.2160	746.0029	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.8491	0.2160	394.1674	(264)
Space and water heating			1140.1703	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			731.9018	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.1700	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.6663	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.6663	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	491.0748	568.6683	640.0081	711.5940	759.4623	746.2500	711.6255	663.7776	609.9173	538.9222	482.4599	464.0122	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9978	0.9950	0.9871	0.9596	0.8805	0.7193	0.5507	0.6074	0.8494	0.9749	0.9953	0.9983	(86)
MIT	19.7243	19.8841	20.1421	20.4836	20.7747	20.9434	20.9880	20.9809	20.8641	20.4866	20.0459	19.7005	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9970	0.9933	0.9824	0.9441	0.8353	0.6274	0.4284	0.4829	0.7776	0.9623	0.9934	0.9977	(89)
MIT 2	18.2350	18.4700	18.8465	19.3420	19.7301	19.9262	19.9596	19.9583	19.8497	19.3556	18.7166	18.2082	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9905	0.9774	0.9371	0.8350	0.6439	0.4537	0.5085	0.7856	0.9564	0.9908	0.9965	(94)
Useful gains	488.8589	563.2682	625.5589	666.8318	634.1592	480.5018	322.8865	337.5593	479.1761	515.4323	478.0287	462.4101	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1348.2853	1308.2782	1186.9455	990.6168	762.9505	505.8679	326.3880	343.6283	547.1576	831.7326	1106.1949	1339.3087	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating												3226.6972	(98)
Space heating per m2											(98) / (4) =	40.4449	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3454.7079	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	684.5966	536.0244	447.1859	249.5987	102.5918	0.0000	0.0000	0.0000	0.0000	251.9566	484.2394	698.5145	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7503	87.5213	87.0461	85.9424	83.8304	80.3000	80.3000	80.3000	80.3000	85.8477	87.2379	87.8354	(217)
Fuel for water heating, kWh/month													
	230.2030	202.5567	211.8976	190.3561	188.9416	173.7253	166.4421	185.5439	187.5930	199.8079	209.8920	224.5539	(219)
Water heating fuel used												2371.5132	(219)
Annual totals kWh/year													
Space heating fuel - main system												3454.7079	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6258.1338	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3454.7079	0.2160	746.2169	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.5132	0.2160	512.2469	(264)
Space and water heating			1258.4638	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1482.6264	(272)
Emissions per m2 for space and water heating			15.7742	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7742 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.5400	
Infiltration rate			0.3725	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3445	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4393	0.4307	0.4221	0.3790	0.3704	0.3273	0.3273	0.3187	0.3445	0.3704	0.3876	0.4048	(22b)
Effective ac	0.5965	0.5927	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5819	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.5944	40.3395	40.0895	38.9156	38.6960	37.6736	37.6736	37.4842	38.0674	38.6960	39.1403	39.6048	(38)
Heat transfer coeff	96.4761	96.2211	95.9712	94.7973	94.5776	93.5552	93.5552	93.3659	93.9490	94.5776	95.0220	95.4865	(39)
Average = Sum(39)m / 12 =												94.7962	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2093	1.2061	1.2029	1.1882	1.1855	1.1727	1.1727	1.1703	1.1776	1.1855	1.1910	1.1969	(40)
HLP (average)												1.1882	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	463.1837	554.5904	641.7594	731.1024	792.2441	783.0400	746.7968	687.4836	621.7718	533.0036	460.2708	434.3728	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6479	34.7397	34.8302	35.2615	35.3434	35.7296	35.7296	35.8021	35.5799	35.3434	35.1781	35.0070	
alpha	3.3099	3.3160	3.3220	3.3508	3.3562	3.3820	3.3820	3.3868	3.3720	3.3562	3.3452	3.3338	
util living area													
	0.9884	0.9785	0.9573	0.9067	0.8090	0.6596	0.5156	0.5701	0.7871	0.9370	0.9806	0.9906	(86)
MIT	19.0527	19.2992	19.6856	20.1780	20.5945	20.8598	20.9547	20.9360	20.7295	20.1774	19.5250	19.0116	(87)
Th 2	19.9126	19.9151	19.9176	19.9294	19.9316	19.9419	19.9419	19.9438	19.9380	19.9316	19.9272	19.9225	(88)
util rest of house													
	0.9859	0.9738	0.9478	0.8851	0.7637	0.5795	0.4056	0.4594	0.7207	0.9180	0.9757	0.9886	(89)
MIT 2	18.1405	18.3864	18.7686	19.2529	19.6368	19.8635	19.9253	19.9182	19.7671	19.2635	18.6213	18.1069	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3289	18.5749	18.9580	19.4440	19.8347	20.0693	20.1379	20.1285	19.9659	19.4523	18.8080	18.2938	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3289	18.5749	18.9580	19.4440	19.8347	20.0693	20.1379	20.1285	19.9659	19.4523	18.8080	18.2938	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9662	0.9371	0.8733	0.7590	0.5899	0.4270	0.4801	0.7227	0.9072	0.9687	0.9843	(94)
Useful gains	454.3376	535.8571	601.3887	638.4995	601.3320	461.9112	318.8883	330.0511	449.3707	483.5373	445.8692	427.5401	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.4574	1315.8175	1195.6089	999.5425	769.3569	511.6793	330.9889	348.1100	551.0988	837.2271	1112.5126	1345.7630	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.9451	524.1334	442.0998	259.9510	125.0106	0.0000	0.0000	0.0000	0.0000	263.1452	479.9832	683.1578	(98)
Space heating												3446.4262	(98)
Space heating per m2											(98) / (4) =	43.1991	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	879.4190	692.3085	709.5806	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8211	0.8796	0.8523	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	722.0678	608.9233	604.8061	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1750	962.9391	895.2359	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	205.2771	263.3878	216.0797	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												684.7447	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	51.3193	65.8470	54.0199	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												171.1862	(107)
Space cooling per m2												2.1457	(108)
Energy for space heating												43.1991	(99)
Energy for space cooling												2.1457	(108)
Total												45.3449	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	446.5894	525.2718	598.8488	673.2482	723.1655	712.5796	679.6484	628.9967	573.7314	499.8465	440.2031	420.2956	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9965	0.9902	0.9671	0.8965	0.7427	0.5737	0.6353	0.8724	0.9814	0.9969	0.9989	(86)
MIT	19.6728	19.8344	20.0967	20.4463	20.7507	20.9346	20.9857	20.9768	20.8435	20.4457	19.9973	19.6497	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9980	0.9952	0.9866	0.9540	0.8549	0.6515	0.4477	0.5078	0.8060	0.9717	0.9956	0.9986	(89)
MIT 2	18.7216	18.8851	19.1478	19.5002	19.7816	19.9335	19.9603	19.9594	19.8706	19.5062	19.0589	18.7075	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9938	0.9839	0.9500	0.8563	0.6684	0.4740	0.5343	0.8145	0.9685	0.9944	0.9980	(94)
Useful gains	445.4046	522.0373	589.1874	639.6046	619.2224	476.2914	322.1453	336.0853	467.2982	484.1171	437.7201	419.4679	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1383.8307	1338.3942	1208.5618	1001.5448	766.2731	506.2326	326.3973	343.6335	548.2885	842.0068	1130.5246	1375.3854	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	698.1891	548.5918	460.8146	260.5969	109.4057	0.0000	0.0000	0.0000	0.0000	266.2699	498.8192	711.2027	(98)
Space heating												3553.8899	(98)
Space heating per m2											(98) / (4) =	44.5461	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8637	0.9242	0.8991	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	741.8790	624.9339	622.8739	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	924.8187	884.4540	826.8746	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	131.7166	193.0830	151.7765	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												476.5760	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	32.9291	48.2707	37.9441	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												119.1440 (107)
Space cooling per m2												1.4934 (108)
Energy for space heating												44.5461 (99)
Energy for space cooling												1.4934 (108)
Total												46.0395 (109)
Target Fabric Energy Efficiency (TFEE)												52.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.5400	
Infiltration rate		0.4210	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4089	0.3797	0.3894	0.3699	0.3699	0.3602	0.3504	0.3407	0.3310	0.3602	0.3407	0.3602	(22b)
Effective ac	0.5836	0.5721	0.5758	0.5684	0.5684	0.5649	0.5614	0.5580	0.5548	0.5649	0.5580	0.5649	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.7164	38.9328	39.1875	38.6845	38.6845	38.4427	38.2073	37.9783	37.7558	38.4427	37.9783	38.4427	(38)
Heat transfer coeff	95.5980	94.8144	95.0692	94.5661	94.5661	94.3243	94.0889	93.8599	93.6374	94.3243	93.8599	94.3243	(39)
Average = Sum(39)m / 12 =												94.4194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1983	1.1884	1.1916	1.1853	1.1853	1.1823	1.1794	1.1765	1.1737	1.1823	1.1765	1.1823	(40)
HLP (average)												1.1835	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	150.1013	226.3572	335.9022	458.8315	522.9339	580.2060	548.2979	487.8708	398.3130	276.7272	181.0596	125.0942	(83)
Total gains	704.0937	775.9471	864.1117	953.9281	984.1568	1011.0942	961.4705	909.3247	838.8363	750.5749	691.9241	663.9362	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9661	35.2551	35.1606	35.3477	35.3477	35.4383	35.5270	35.6136	35.6983	35.4383	35.6136	35.4383	
alpha	3.3311	3.3503	3.3440	3.3565	3.3565	3.3626	3.3685	3.3742	3.3799	3.3626	3.3742	3.3626	
util living area	0.9585	0.9427	0.9023	0.8181	0.6873	0.5000	0.3723	0.3912	0.6225	0.8371	0.9316	0.9636	(86)
MIT	19.5366	19.7147	20.0649	20.4783	20.7835	20.9453	20.9847	20.9824	20.8845	20.5287	20.0039	19.5216	(87)
Th 2	19.9214	19.9293	19.9267	19.9317	19.9317	19.9342	19.9366	19.9389	19.9411	19.9342	19.9389	19.9342	(88)
util rest of house	0.9503	0.9316	0.8833	0.7832	0.6284	0.4173	0.2749	0.2897	0.5412	0.7970	0.9161	0.9562	(89)
MIT 2	18.0194	18.2778	18.7699	19.3361	19.7219	19.8964	19.9301	19.9314	19.8493	19.4192	18.7015	18.0071	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.3328	18.5746	19.0374	19.5720	19.9412	20.1130	20.1480	20.1485	20.0631	19.6484	18.9705	18.3200	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1828	18.4246	18.8874	19.4220	19.7912	19.9630	19.9980	19.9985	19.9131	19.4984	18.8205	18.1700	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9113	0.8606	0.7640	0.6199	0.4196	0.2807	0.2956	0.5389	0.7775	0.8949	0.9394	(94)
Useful gains	656.3921	707.1086	743.6714	728.8487	610.1204	424.2994	269.8546	268.7829	452.0323	583.5696	619.1788	623.7212	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.8084	1244.4027	1130.1228	938.2896	689.4975	439.8387	272.6664	272.0498	488.1445	763.8721	1024.9974	1242.2466	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	456.3818	361.0616	287.5198	150.7974	59.0565	0.0000	0.0000	0.0000	0.0000	134.1450	292.1894	460.1829	(98)

Space heating 2201.3345 (98)
RHI space heating demand 2201 (98)

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.5400	
Infiltration rate			0.4210	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4965	0.4867	0.4770	0.4283	0.4186	0.3699	0.3699	0.3602	0.3894	0.4186	0.4381	0.4575	(22b)
Effective ac	0.6232	0.6185	0.6138	0.5917	0.5876	0.5684	0.5684	0.5649	0.5758	0.5876	0.5959	0.6047	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4154	42.0897	41.7705	40.2710	39.9905	38.6845	38.6845	38.4427	39.1875	39.9905	40.5580	41.1513	(38)
Heat transfer coeff	98.2970	97.9713	97.6521	96.1526	95.8721	94.5661	94.5661	94.3243	95.0692	95.8721	96.4396	97.0330	(39)
Average = Sum(39)m / 12 =												96.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2321	1.2280	1.2240	1.2052	1.2017	1.1853	1.1853	1.1823	1.1916	1.2017	1.2088	1.2163	(40)
HLP (average)												1.2052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231 (83)
Total gains	674.9649	763.3234	841.0289	916.8548	964.8069	944.5453	902.6854	847.8243	790.7385	715.5636	657.1589	641.4651 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0061	34.1191	34.2306	34.7644	34.8662	35.3477	35.3477	35.4383	35.1606	34.8662	34.6610	34.4490	
alpha	3.2671	3.2746	3.2820	3.3176	3.3244	3.3565	3.3565	3.3626	3.3440	3.3244	3.3107	3.2966	
util living area													
	0.9670	0.9498	0.9177	0.8503	0.7376	0.5804	0.4418	0.4840	0.6934	0.8770	0.9495	0.9715	(86)
MIT	19.3403	19.5680	19.9166	20.3512	20.6955	20.9031	20.9707	20.9600	20.8174	20.3749	19.7901	19.3029	(87)
Th 2	19.8944	19.8977	19.9008	19.9158	19.9186	19.9317	19.9317	19.9342	19.9267	19.9186	19.9130	19.9070	(88)
util rest of house													
	0.9604	0.9401	0.9014	0.8205	0.6858	0.5014	0.3423	0.3827	0.6194	0.8458	0.9381	0.9658	(89)
MIT 2	17.7198	18.0477	18.5447	19.1559	19.6057	19.8557	19.9167	19.9120	19.7674	19.2045	18.3815	17.6741	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0545	18.3617	18.8281	19.4029	19.8308	20.0721	20.1344	20.1285	19.9843	19.4463	18.6725	18.0106	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9045	18.2117	18.6781	19.2529	19.6808	19.9221	19.9844	19.9785	19.8343	19.2963	18.5225	17.8606	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9439	0.9201	0.8785	0.7989	0.6731	0.5007	0.3474	0.3871	0.6124	0.8237	0.9182	0.9507	(94)
Useful gains	637.1090	702.3586	738.8590	732.5047	649.4333	472.9122	313.6181	328.1870	484.2246	589.4001	603.4217	609.8144	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1337.2832	1304.1678	1189.2187	995.4546	765.1405	503.2860	320.0501	337.5354	545.1542	833.7312	1101.5779	1325.5262	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	520.9296	404.4158	335.0676	189.3240	86.0862	0.0000	0.0000	0.0000	0.0000	181.7823	358.6724	532.4896	(98)
Space heating												2608.7675	(98)
Space heating per m2											(98) / (4) =	32.6995	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2882.6160	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.9296	404.4158	335.0676	189.3240	86.0862	0.0000	0.0000	0.0000	0.0000	181.7823	358.6724	532.4896	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	575.6128	446.8683	370.2404	209.1978	95.1229	0.0000	0.0000	0.0000	0.0000	200.8645	396.3231	588.3863	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7084	89.6336	89.4839	89.1550	88.5590	87.3000	87.3000	87.3000	87.3000	89.0939	89.5398	89.7386	(217)
Fuel for water heating, kWh/month													
	184.1119	161.5926	168.0591	148.5267	144.5722	128.1956	120.4190	135.8687	136.8056	154.2624	165.6618	178.7264	(219)
Water heating fuel used												1826.8019	(219)
Annual totals kWh/year													
Space heating fuel - main system												2882.6160	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3922.7735	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2882.6160	3.4800	100.3150	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.8019	3.4800	63.5727	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			180.1293	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6063	(257)
SAP value		91.5421	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2882.6160	0.2160	622.6451	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.8019	0.2160	394.5892	(264)
Space and water heating			1017.2343	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			608.9658	(272)
CO2 emissions per m2			7.6300	(273)
EI value			93.4604	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.5400	
Infiltration rate		0.4210	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4089	0.3797	0.3894	0.3699	0.3699	0.3602	0.3504	0.3407	0.3310	0.3602	0.3407	0.3602	(22b)
Effective ac	0.5836	0.5721	0.5758	0.5684	0.5684	0.5649	0.5614	0.5580	0.5548	0.5649	0.5580	0.5649	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.7164	38.9328	39.1875	38.6845	38.6845	38.4427	38.2073	37.9783	37.7558	38.4427	37.9783	38.4427	(38)
Heat transfer coeff	95.5980	94.8144	95.0692	94.5661	94.5661	94.3243	94.0889	93.8599	93.6374	94.3243	93.8599	94.3243	(39)
Average = Sum(39)m / 12 =												94.4194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1983	1.1884	1.1916	1.1853	1.1853	1.1823	1.1794	1.1765	1.1737	1.1823	1.1765	1.1823	(40)
HLP (average)												1.1835	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	150.1013	226.3572	335.9022	458.8315	522.9339	580.2060	548.2979	487.8708	398.3130	276.7272	181.0596	125.0942	(83)
Total gains	704.0937	775.9471	864.1117	953.9281	984.1568	1011.0942	961.4705	909.3247	838.8363	750.5749	691.9241	663.9362	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9661	35.2551	35.1606	35.3477	35.3477	35.4383	35.5270	35.6136	35.6983	35.4383	35.6136	35.4383	
alpha	3.3311	3.3503	3.3440	3.3565	3.3565	3.3626	3.3685	3.3742	3.3799	3.3626	3.3742	3.3626	
util living area													
	0.9585	0.9427	0.9023	0.8181	0.6873	0.5000	0.3723	0.3912	0.6225	0.8371	0.9316	0.9636	(86)
MIT	19.5366	19.7147	20.0649	20.4783	20.7835	20.9453	20.9847	20.9824	20.8845	20.5287	20.0039	19.5216	(87)
Th 2	19.9214	19.9293	19.9267	19.9317	19.9317	19.9342	19.9366	19.9389	19.9411	19.9342	19.9389	19.9342	(88)
util rest of house													
	0.9503	0.9316	0.8833	0.7832	0.6284	0.4173	0.2749	0.2897	0.5412	0.7970	0.9161	0.9562	(89)
MIT 2	18.0194	18.2778	18.7699	19.3361	19.7219	19.8964	19.9301	19.9314	19.8493	19.4192	18.7015	18.0071	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3328	18.5746	19.0374	19.5720	19.9412	20.1130	20.1480	20.1485	20.0631	19.6484	18.9705	18.3200	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1828	18.4246	18.8874	19.4220	19.7912	19.9630	19.9980	19.9985	19.9131	19.4984	18.8205	18.1700	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9113	0.8606	0.7640	0.6199	0.4196	0.2807	0.2956	0.5389	0.7775	0.8949	0.9394	(94)
Useful gains	656.3921	707.1086	743.6714	728.8487	610.1204	424.2994	269.8546	268.7829	452.0323	583.5696	619.1788	623.7212	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1269.8084	1244.4027	1130.1228	938.2896	689.4975	439.8387	272.6664	272.0498	488.1445	763.8721	1024.9974	1242.2466	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	456.3818	361.0616	287.5198	150.7974	59.0565	0.0000	0.0000	0.0000	0.0000	134.1450	292.1894	460.1829	(98)
Space heating												2201.3345	(98)
Space heating per m2											(98) / (4) =	27.5926	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2432.4138	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	456.3818	361.0616	287.5198	150.7974	59.0565	0.0000	0.0000	0.0000	0.0000	134.1450	292.1894	460.1829	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	504.2892	398.9631	317.7014	166.6269	65.2558	0.0000	0.0000	0.0000	0.0000	148.2265	322.8612	508.4894	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6270	89.5601	89.3749	88.9751	88.2854	87.3000	87.3000	87.3000	87.3000	88.8518	89.3966	89.6507	(217)
Fuel for water heating, kWh/month													
	184.2792	161.7252	168.2640	148.8270	145.0202	128.1956	120.4190	135.8687	136.8056	154.6828	165.9271	178.9016	(219)
Water heating fuel used												1828.9157	(219)
Annual totals kWh/year													
Space heating fuel - main system												2432.4138	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3324.2650	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2432.4138	10.2300	248.8359	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.9157	10.2300	187.0981	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			194.8439	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2432.4138	0.2160	525.4014	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9157	0.2160	395.0458	(264)
Space and water heating			920.4472	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			434.1107	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2432.4138	1.2200	2967.5448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9157	1.2200	2231.2772	(264)
Space and water heating			5198.8220	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2322.0340	(272)
Primary energy kWh/m2/year			29.1055	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (42.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£539	£439	£100
Space heating	£379	£379	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£195	£113	£82
Total cost of uses	£194	£113	£81
Delivered energy	42 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.5400	
Infiltration rate			0.4210	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4965	0.4867	0.4770	0.4283	0.4186	0.3699	0.3699	0.3602	0.3894	0.4186	0.4381	0.4575	(22b)
Effective ac	0.6232	0.6185	0.6138	0.5917	0.5876	0.5684	0.5684	0.5649	0.5758	0.5876	0.5959	0.6047	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4154	42.0897	41.7705	40.2710	39.9905	38.6845	38.6845	38.4427	39.1875	39.9905	40.5580	41.1513	(38)
Heat transfer coeff	98.2970	97.9713	97.6521	96.1526	95.8721	94.5661	94.5661	94.3243	95.0692	95.8721	96.4396	97.0330	(39)
Average = Sum(39)m / 12 =												96.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2321	1.2280	1.2240	1.2052	1.2017	1.1853	1.1853	1.1823	1.1916	1.2017	1.2088	1.2163	(40)
HLP (average)												1.2052	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)
								Solar input (sum of months) = Sum(63)m =				-843.3953 (63)
Output from w/h												
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)
								Total per year (kWh/year) = Sum(64)m =				786.4412 (64)
Heat gains from water heating, kWh/month												
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231 (83)
Total gains	674.9649	763.3234	841.0289	916.8548	964.8069	944.5453	902.6854	847.8243	790.7385	715.5636	657.1589	641.4651 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0061	34.1191	34.2306	34.7644	34.8662	35.3477	35.3477	35.4383	35.1606	34.8662	34.6610	34.4490	
alpha	3.2671	3.2746	3.2820	3.3176	3.3244	3.3565	3.3565	3.3626	3.3440	3.3244	3.3107	3.2966	
util living area													
	0.9670	0.9498	0.9177	0.8503	0.7376	0.5804	0.4418	0.4840	0.6934	0.8770	0.9495	0.9715	(86)
MIT	19.3403	19.5680	19.9166	20.3512	20.6955	20.9031	20.9707	20.9600	20.8174	20.3749	19.7901	19.3029	(87)
Th 2	19.8944	19.8977	19.9008	19.9158	19.9186	19.9317	19.9317	19.9342	19.9267	19.9186	19.9130	19.9070	(88)
util rest of house													
	0.9604	0.9401	0.9014	0.8205	0.6858	0.5014	0.3423	0.3827	0.6194	0.8458	0.9381	0.9658	(89)
MIT 2	17.7198	18.0477	18.5447	19.1559	19.6057	19.8557	19.9167	19.9120	19.7674	19.2045	18.3815	17.6741	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0545	18.3617	18.8281	19.4029	19.8308	20.0721	20.1344	20.1285	19.9843	19.4463	18.6725	18.0106	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9045	18.2117	18.6781	19.2529	19.6808	19.9221	19.9844	19.9785	19.8343	19.2963	18.5225	17.8606	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9439	0.9201	0.8785	0.7989	0.6731	0.5007	0.3474	0.3871	0.6124	0.8237	0.9182	0.9507	(94)
Useful gains	637.1090	702.3586	738.8590	732.5047	649.4333	472.9122	313.6181	328.1870	484.2246	589.4001	603.4217	609.8144	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1337.2832	1304.1678	1189.2187	995.4546	765.1405	503.2860	320.0501	337.5354	545.1542	833.7312	1101.5779	1325.5262	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	520.9296	404.4158	335.0676	189.3240	86.0862	0.0000	0.0000	0.0000	0.0000	181.7823	358.6724	532.4896	(98)
Space heating												2608.7675	(98)
Space heating per m2											(98) / (4) =	32.6995	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2882.6160	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.9296	404.4158	335.0676	189.3240	86.0862	0.0000	0.0000	0.0000	0.0000	181.7823	358.6724	532.4896	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	575.6128	446.8683	370.2404	209.1978	95.1229	0.0000	0.0000	0.0000	0.0000	200.8645	396.3231	588.3863	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8000	89.8263	89.8595	89.9337	90.0683	87.3000	87.3000	87.3000	87.3000	89.4531	89.6794	89.8149	(217)
Fuel for water heating, kWh/month													
	156.6895	115.8123	90.0066	43.6618	14.3778	0.0000	0.0000	24.1300	49.2919	95.3199	133.0561	155.7874	(219)
Water heating fuel used												878.1332	(219)
Annual totals kWh/year													
Space heating fuel - main system												2882.6160	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3024.1048	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2882.6160	3.4800	100.3150	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.1332	3.4800	30.5590	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			153.7107	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5174	(257)
SAP value	92.7826	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2882.6160	0.2160	622.6451	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.1332	0.2160	189.6768	(264)
Space and water heating			812.3218	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			430.0034	(272)
CO2 emissions per m2			5.3900	(273)
EI value			95.3822	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.5400	
Infiltration rate		0.4210	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3894	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4089	0.3797	0.3894	0.3699	0.3699	0.3602	0.3504	0.3407	0.3310	0.3602	0.3407	0.3602	(22b)
Effective ac	0.5836	0.5721	0.5758	0.5684	0.5684	0.5649	0.5614	0.5580	0.5548	0.5649	0.5580	0.5649	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.7164	38.9328	39.1875	38.6845	38.6845	38.4427	38.2073	37.9783	37.7558	38.4427	37.9783	38.4427	(38)
Heat transfer coeff	95.5980	94.8144	95.0692	94.5661	94.5661	94.3243	94.0889	93.8599	93.6374	94.3243	93.8599	94.3243	(39)
Average = Sum(39)m / 12 =												94.4194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1983	1.1884	1.1916	1.1853	1.1853	1.1823	1.1794	1.1765	1.1737	1.1823	1.1765	1.1823	(40)
HLP (average)												1.1835	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(77)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(77)

Solar gains	150.1013	226.3572	335.9022	458.8315	522.9339	580.2060	548.2979	487.8708	398.3130	276.7272	181.0596	125.0942	(83)
Total gains	704.0937	775.9471	864.1117	953.9281	984.1568	1011.0942	961.4705	909.3247	838.8363	750.5749	691.9241	663.9362	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9661	35.2551	35.1606	35.3477	35.3477	35.4383	35.5270	35.6136	35.6983	35.4383	35.6136	35.4383	
alpha	3.3311	3.3503	3.3440	3.3565	3.3565	3.3626	3.3685	3.3742	3.3799	3.3626	3.3742	3.3626	
util living area													
	0.9585	0.9427	0.9023	0.8181	0.6873	0.5000	0.3723	0.3912	0.6225	0.8371	0.9316	0.9636	(86)
MIT	19.5366	19.7147	20.0649	20.4783	20.7835	20.9453	20.9847	20.9824	20.8845	20.5287	20.0039	19.5216	(87)
Th 2	19.9214	19.9293	19.9267	19.9317	19.9317	19.9342	19.9366	19.9389	19.9411	19.9342	19.9389	19.9342	(88)
util rest of house													
	0.9503	0.9316	0.8833	0.7832	0.6284	0.4173	0.2749	0.2897	0.5412	0.7970	0.9161	0.9562	(89)
MIT 2	18.0194	18.2778	18.7699	19.3361	19.7219	19.8964	19.9301	19.9314	19.8493	19.4192	18.7015	18.0071	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3328	18.5746	19.0374	19.5720	19.9412	20.1130	20.1480	20.1485	20.0631	19.6484	18.9705	18.3200	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1828	18.4246	18.8874	19.4220	19.7912	19.9630	19.9980	19.9985	19.9131	19.4984	18.8205	18.1700	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9113	0.8606	0.7640	0.6199	0.4196	0.2807	0.2956	0.5389	0.7775	0.8949	0.9394	(94)
Useful gains	656.3921	707.1086	743.6714	728.8487	610.1204	424.2994	269.8546	268.7829	452.0323	583.5696	619.1788	623.7212	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.8084	1244.4027	1130.1228	938.2896	689.4975	439.8387	272.6664	272.0498	488.1445	763.8721	1024.9974	1242.2466	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	456.3818	361.0616	287.5198	150.7974	59.0565	0.0000	0.0000	0.0000	0.0000	134.1450	292.1894	460.1829	(98)
Space heating												2201.3345	(98)
Space heating per m2											(98) / (4) =	27.5926	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2432.4138	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	456.3818	361.0616	287.5198	150.7974	59.0565	0.0000	0.0000	0.0000	0.0000	134.1450	292.1894	460.1829	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	504.2892	398.9631	317.7014	166.6269	65.2558	0.0000	0.0000	0.0000	0.0000	148.2265	322.8612	508.4894	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7422	89.7630	89.7796	89.8339	89.7510	87.3000	87.3000	87.3000	87.3000	89.2644	89.5753	89.7457	(217)
Fuel for water heating, kWh/month	152.2160	116.1148	89.7549	42.5638	19.3970	0.0000	0.0000	17.2721	43.9527	91.1852	127.8835	152.5424	(219)
Water heating fuel used												852.8823	(219)

Annual totals kWh/year		
Space heating fuel - main system	2432.4138	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =	-1368.9771	(233)
Total delivered energy for all uses	2398.2316	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2432.4138	10.2300	248.8359	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.8823	10.2300	87.2499	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			113.3557	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2432.4138	0.2160	525.4014	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8823	0.2160	184.2226	(264)
Space and water heating			709.6240	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			249.2375	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2432.4138	1.2200	2967.5448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8823	1.2200	1040.5164	(264)
Space and water heating			4008.0612	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1284.7732	(272)
Primary energy kWh/m2/year			16.1040	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						609.3842

	Jun	Jul	Aug	
Solar gains	647	609	541	(P4)
Internal gains	428	410	418	
Total summer gains	1075	1020	960	(P5)
Summer gain/loss ratio	3.28	3.11	2.93	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.22	21.95	21.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-341.R	**Issued on Date**	04/10/2023
Assessment Reference	As Built	**Prop Type Ref**	FF-2BMW-As-DET
Property	15, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.32	**TER**	20.62
Environmental	93 A	**% DER<TER**	49.96		
CO_2 Emissions (t/year)	0.44	**DFEE**	52.55	**TFEE**	61.69
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.81		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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DWELLING AS BUILT

Semi-Detached Maisonette, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.62 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.32 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)61.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 4.78 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.90 m², No overhang
Windows facing South East: 4.31 m², No overhang
Windows facing South West: 0.82 m², No overhang
Windows facing North West: 2.22 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		4.7800	
Infiltration rate		0.3549	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3283	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4186	0.4104	0.4022	0.3611	0.3529	0.3119	0.3119	0.3037	0.3283	0.3529	0.3693	0.3858	(22b)
Effective ac	0.5876	0.5842	0.5809	0.5652	0.5623	0.5486	0.5486	0.5461	0.5539	0.5623	0.5682	0.5744	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.4547	33.2611	33.0712	32.1795	32.0126	31.2360	31.2360	31.0922	31.5351	32.0126	32.3502	32.7030	(38)
Heat transfer coeff	96.0689	95.8752	95.6853	94.7936	94.6268	93.8501	93.8501	93.7063	94.1493	94.6268	94.9643	95.3171	(39)
Average = Sum(39)m / 12 =												94.7928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3016	1.2989	1.2964	1.2843	1.2820	1.2715	1.2715	1.2696	1.2756	1.2820	1.2866	1.2914	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
								Total per year (kWh/year) = Sum(64)m =				1581.8514	(64)
Heat gains from water heating, kWh/month	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains	356.3565	354.2863	341.4283	320.7574	299.8453	279.6684	266.5558	272.3804	282.9996	303.8752	327.8321	345.7282	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	451.6671	526.0869	601.5981	685.1997	746.4591	739.9470	703.2827	645.2209	578.8720	500.5204	443.7134	426.1805	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.5262	49.6262	49.7247	50.1925	50.2810	50.6971	50.6971	50.7749	50.5360	50.2810	50.1023	49.9168	
alpha	4.3017	4.3084	4.3150	4.3462	4.3521	4.3798	4.3798	4.3850	4.3691	4.3521	4.3402	4.3278	
util living area	0.9969	0.9936	0.9844	0.9542	0.8734	0.7208	0.5622	0.6254	0.8574	0.9734	0.9941	0.9976	(86)
MIT	19.4875	19.6614	19.9568	20.3515	20.7000	20.9114	20.9769	20.9637	20.7981	20.3464	19.8449	19.4556	(87)
Th 2	19.8396	19.8417	19.8437	19.8532	19.8549	19.8632	19.8632	19.8648	19.8600	19.8549	19.8513	19.8476	(88)
util rest of house	0.9959	0.9915	0.9791	0.9374	0.8264	0.6249	0.4289	0.4906	0.7863	0.9605	0.9918	0.9968	(89)
MIT 2	17.8375	18.0923	18.5222	19.0905	19.5567	19.8023	19.8544	19.8490	19.6919	19.0939	18.3676	17.7962	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.2059	18.4426	18.8425	19.3721	19.8120	20.0499	20.1050	20.0979	19.9389	19.3735	18.6974	18.1667	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0559	18.2926	18.6925	19.2221	19.6620	19.8999	19.9550	19.9479	19.7889	19.2235	18.5474	18.0167	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9935	0.9873	0.9714	0.9251	0.8169	0.6283	0.4403	0.5012	0.7808	0.9503	0.9878	0.9949	(94)
Useful gains	448.7230	519.3824	584.3645	633.9067	609.7887	464.9384	309.6482	323.4062	452.0048	475.6412	438.2945	423.9911	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1321.5120	1284.0219	1166.6414	978.4675	753.4163	497.3986	314.8664	332.4616	535.6061	816.0173	1087.0964	1316.9709	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	649.3550	513.8378	433.2141	248.0838	106.8590	0.0000	0.0000	0.0000	0.0000	253.2398	467.1374	664.3770	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			3336.1038 (98)
Space heating per m2		(98) / (4) =	45.1985 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3686.3025 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	649.3550	513.8378	433.2141	248.0838	106.8590	0.0000	0.0000	0.0000	0.0000	253.2398	467.1374	664.3770	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	717.5194	567.7765	478.6896	274.1257	118.0762	0.0000	0.0000	0.0000	0.0000	279.8230	516.1739	734.1182	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8460	89.7908	89.6691	89.3784	88.7468	87.3000	87.3000	87.3000	87.3000	89.3663	89.7228	89.8727	(217)
Fuel for water heating, kWh/month	179.0858	157.1637	163.4606	144.4842	140.7536	125.1678	117.6677	132.6356	133.5125	149.9794	161.1172	173.8828	(219)
Water heating fuel used												1778.9110	(219)
Annual totals kWh/year													
Space heating fuel - main system												3686.3025	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4657.6809	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3686.3025	0.2160	796.2413	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1778.9110	0.2160	384.2448	(264)
Space and water heating			1180.4861	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			761.3767	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.3200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.3200	ZC1
Total Floor Area	TFA	73.8100	
Assumed number of occupants	N	2.3350	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5403	ZC2
CO2 emissions from cooking, equation (L16)		2.3715	ZC3
Total CO2 emissions		29.2318	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.2318	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1739	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4239	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3921	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4999	0.4901	0.4803	0.4313	0.4215	0.3725	0.3725	0.3627	0.3921	0.4215	0.4411	0.4607	(22b)
Effective ac	0.6250	0.6201	0.6154	0.5930	0.5888	0.5694	0.5694	0.5658	0.5769	0.5888	0.5973	0.6061	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
GF B&B J150 P/A=1+			4.9400	0.1300	0.6422			(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.1800	13.3236			(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.1800	0.0180			(29a)
Wall to Void	15.3500		15.3500	0.1800	2.7630			(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.1300	0.4979			(30)
Plane	68.5000		68.5000	0.1300	8.9050			(30)
Sloping	10.5200		10.5200	0.1300	1.3676			(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8878			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		15.2530 (36)
Total fabric heat loss	(33) + (36) =	61.1408 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.5813	35.3051	35.0343	33.7624	33.5244	32.4166	32.4166	32.2115	32.8433	33.5244	34.0058	34.5091	(38)
Heat transfer coeff	96.7222	96.4459	96.1751	94.9032	94.6652	93.5574	93.5574	93.3523	93.9842	94.6652	95.1466	95.6499	(39)
Average = Sum(39)m / 12 =												94.9021	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3104	1.3067	1.3030	1.2858	1.2826	1.2675	1.2675	1.2648	1.2733	1.2826	1.2891	1.2959	(40)
HLP (average)												1.2858	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350 (42)
Average daily hot water use (litres/day)	89.6553 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.2561	43.7420	46.6011	43.3293	42.9461	39.7922	41.1186	42.9461	43.3293	46.6011	46.8664	50.2561 (61)

Total heat required for water heating calculated for each month

	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932 (64)
								Total per year (kWh/year) = Sum(64)m =				1948.4118 (64)

Heat gains from water heating, kWh/month

	61.1928	53.4665	55.5385	49.0951	47.4506	41.6295	39.6372	44.4247	44.9228	51.3795	55.0841	59.6584 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)

Water heating gains (Table 5)

	82.2484	79.5633	74.6485	68.1877	63.7777	57.8187	53.2758	59.7106	62.3928	69.0585	76.5058	80.1860	(72)

Total internal gains

	368.3211	365.6465	352.1884	330.9198	309.4051	288.6279	275.5236	281.9480	293.1734	314.6469	339.1988	357.6973	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.6300	0.7000	0.7700	16.8962	(75)
Southeast	4.3100	36.7938	0.6300	0.7000	0.7700	48.4645	(77)
Southwest	0.8200	36.7938	0.6300	0.7000	0.7700	9.2206	(79)
Northwest	2.2200	11.2829	0.6300	0.7000	0.7700	7.6550	(81)

Solar gains	82.2365	148.2340	224.4813	314.4503	385.3500	397.1403	376.8194	321.6965	255.2865	169.6706	99.9854	69.4163	(83)
Total gains	450.5575	513.8805	576.6697	645.3701	694.7552	685.7682	652.3429	603.6444	548.4599	484.3174	439.1842	427.1136	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9940	53.1458	53.2954	54.0097	54.1455	54.7866	54.7866	54.9070	54.5379	54.1455	53.8715	53.5881	
alpha	4.5329	4.5431	4.5530	4.6006	4.6097	4.6524	4.6524	4.6605	4.6359	4.6097	4.5914	4.5725	
util living area													
	0.9978	0.9956	0.9894	0.9678	0.9037	0.7631	0.6015	0.6622	0.8839	0.9803	0.9958	0.9983	(86)
MIT	19.5589	19.7120	19.9800	20.3497	20.6863	20.9060	20.9760	20.9630	20.7963	20.3667	19.9015	19.5368	(87)
Th 2	19.8327	19.8356	19.8385	19.8520	19.8545	19.8663	19.8663	19.8685	19.8618	19.8545	19.8494	19.8441	(88)
util rest of house													
	0.9970	0.9940	0.9854	0.9545	0.8621	0.6671	0.4610	0.5223	0.8173	0.9698	0.9940	0.9977	(89)
MIT 2	17.9257	18.1511	18.5429	19.0821	19.5397	19.8021	19.8575	19.8530	19.6918	19.1150	18.4380	17.9012	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.2904	18.4996	18.8637	19.3651	19.7957	20.0486	20.1073	20.1009	19.9384	19.3945	18.7648	18.2664	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2904	18.4996	18.8637	19.3651	19.7957	20.0486	20.1073	20.1009	19.9384	19.3945	18.7648	18.2664	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9913	0.9806	0.9471	0.8595	0.6843	0.4926	0.5534	0.8228	0.9638	0.9914	0.9964	(94)
Useful gains	448.4972	509.4286	565.4576	611.2122	597.1717	469.2644	321.3219	334.0327	451.2492	466.8046	435.4023	425.5762	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.1800	1311.6287	1189.0839	993.1704	766.3846	509.7529	328.1295	345.4856	548.7163	832.5338	1109.8629	1345.4472	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	673.0840	539.0785	463.9780	275.0099	125.8944	0.0000	0.0000	0.0000	0.0000	272.1025	485.6116	684.3840	(98)
Space heating												3519.1429	(98)
Space heating per m2											(98) / (4) =	47.6784	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3767.8190	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	673.0840	539.0785	463.9780	275.0099	125.8944	0.0000	0.0000	0.0000	0.0000	272.1025	485.6116	684.3840	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	720.6467	577.1718	496.7644	294.4432	134.7906	0.0000	0.0000	0.0000	0.0000	291.3303	519.9268	732.7452	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9016	87.7348	87.3465	86.4270	84.5590	80.3000	80.3000	80.3000	80.3000	86.2864	87.4580	87.9768	(217)
Fuel for water heating, kWh/month													
	223.5546	195.6519	204.4681	183.2823	181.3695	168.2127	161.1605	179.6562	181.6403	192.4840	202.7204	218.1180	(219)
Water heating fuel used												2292.3185	(219)
Annual totals kWh/year													
Space heating fuel - main system												3767.8190	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Total delivered energy for all uses												6471.1619	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3767.8190	0.2160	813.8489	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2292.3185	0.2160	495.1408	(264)
Space and water heating			1308.9897	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Total CO2, kg/m2/year			1522.3114	(272)
Emissions per m2 for space and water heating			17.7346	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3628	(272b)
Emissions per m2 for pumps and fans			0.5274	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.7346 * 1.00) + 2.3628 + 0.5274, rounded to 2 d.p.			20.6200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1739	(8)
Pressure test			Yes	
Measured/design AP50			4.7800	
Infiltration rate			0.4129	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3819	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4869	0.4774	0.4679	0.4201	0.4106	0.3628	0.3628	0.3533	0.3819	0.4106	0.4297	0.4488	(22b)
Effective ac	0.6186	0.6140	0.6094	0.5882	0.5843	0.5658	0.5658	0.5624	0.5729	0.5843	0.5923	0.6007	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			30.0000	2066.1000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			9.0000	44.4600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14329.2660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		194.1372 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.2169	34.9548	34.6979	33.4911	33.2653	32.2143	32.2143	32.0196	32.6191	33.2653	33.7221	34.1996	(38)
Heat transfer coeff	97.8310	97.5689	97.3120	96.1052	95.8794	94.8284	94.8284	94.6338	95.2332	95.8794	96.3362	96.8137	(39)
Average = Sum(39)m / 12 =												96.1041	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3254	1.3219	1.3184	1.3021	1.2990	1.2848	1.2848	1.2821	1.2902	1.2990	1.3052	1.3117	(40)
HLP (average)												1.3020	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	31.0785	27.1815	28.0488	24.4537	23.4639	20.2475	18.7623	21.5300	21.7872	25.3909	27.7161	30.0979	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	41.7722	40.4486	37.7001	33.9634	31.5375	28.1216	25.2182	28.9382	30.2600	34.1275	38.4946	40.4542	(72)
Total internal gains													
	324.8449	323.5318	312.2400	293.6955	274.1649	255.9307	244.4660	248.1755	258.0406	276.7159	298.1877	314.9655	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	420.1555	495.3324	572.4098	658.1378	720.7787	716.2093	681.1929	621.0160	553.9130	473.3611	414.0690	395.4178	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.6860	40.7953	40.9030	41.4166	41.5141	41.9743	41.9743	42.0606	41.7958	41.5141	41.3173	41.1135	
alpha	3.7124	3.7197	3.7269	3.7611	3.7676	3.7983	3.7983	3.8040	3.7864	3.7676	3.7545	3.7409	
util living area													
	0.9952	0.9906	0.9791	0.9453	0.8651	0.7216	0.5718	0.6347	0.8528	0.9673	0.9915	0.9962	(86)
MIT	19.1915	19.3919	19.7327	20.1916	20.5989	20.8648	20.9583	20.9382	20.7231	20.1933	19.6127	19.1610	(87)
Th 2	19.8210	19.8237	19.8264	19.8392	19.8416	19.8528	19.8528	19.8549	19.8485	19.8416	19.8368	19.8317	(88)
util rest of house													
	0.9939	0.9880	0.9729	0.9280	0.8205	0.6309	0.4403	0.5037	0.7864	0.9538	0.9887	0.9951	(89)
MIT 2	18.1833	18.3845	18.7241	19.1806	19.5586	19.7833	19.8400	19.8336	19.6808	19.1914	18.6152	18.1608	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.4084	18.6094	18.9493	19.4063	19.7909	20.0248	20.0897	20.0803	19.9135	19.4151	18.8379	18.3841	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4084	18.6094	18.9493	19.4063	19.7909	20.0248	20.0897	20.0803	19.9135	19.4151	18.8379	18.3841	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9842	0.9668	0.9200	0.8183	0.6459	0.4692	0.5317	0.7909	0.9471	0.9853	0.9932	(94)
Useful gains	416.6094	487.5118	553.3906	605.4560	589.7843	462.5960	319.6057	330.2075	438.0792	448.3387	407.9791	392.7379	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1380.2375	1337.6123	1211.4632	1009.7098	775.7463	514.4249	330.9230	348.2766	553.6424	845.1878	1130.7847	1373.2180	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	716.9392	571.2675	489.6060	291.0628	138.3558	0.0000	0.0000	0.0000	0.0000	295.2557	520.4200	729.4772	(98)
Space heating												3752.3842	(98)
Space heating per m2											(98) / (4) =	50.8384	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	891.3869	701.7301	719.2166	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8056	0.8711	0.8372	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	718.1409	611.2718	602.1618	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	924.1788	881.5022	812.6774	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	148.3473	201.0514	156.6236	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												506.0223	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	37.0868	50.2628	39.1559	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.5056	(107)
Space cooling per m2												1.7139	(108)
Energy for space heating												50.8384	(99)
Energy for space cooling												1.7139	(108)
Total												52.5524	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1739	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4239	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3921	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4999	0.4901	0.4803	0.4313	0.4215	0.3725	0.3725	0.3627	0.3921	0.4215	0.4411	0.4607	(22b)
Effective ac	0.6250	0.6201	0.6154	0.5930	0.5888	0.5694	0.5694	0.5658	0.5769	0.5888	0.5973	0.6061	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
GF B&B J150 P/A=1+			4.9400	0.1300	0.6422			(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.1800	13.3236			(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.1800	0.0180			(29a)
Wall to Void	15.3500		15.3500	0.1800	2.7630			(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.1300	0.4979			(30)
Plane	68.5000		68.5000	0.1300	8.9050			(30)
Sloping	10.5200		10.5200	0.1300	1.3676			(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8878			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.2530	(36)
Total fabric heat loss (33) + (36) =	61.1408	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.5813	35.3051	35.0343	33.7624	33.5244	32.4166	32.4166	32.2115	32.8433	33.5244	34.0058	34.5091	(38)
Heat transfer coeff	96.7222	96.4459	96.1751	94.9032	94.6652	93.5574	93.5574	93.3523	93.9842	94.6652	95.1466	95.6499	(39)
Average = Sum(39)m / 12 =												94.9021	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3104	1.3067	1.3030	1.2858	1.2826	1.2675	1.2675	1.2648	1.2733	1.2826	1.2891	1.2959	(40)
HLP (average)												1.2858	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350	(42)
Average daily hot water use (litres/day)	89.6553	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)

Heat gains from water heating, kWh/month

	31.0785	27.1815	28.0488	24.4537	23.4639	20.2475	18.7623	21.5300	21.7872	25.3909	27.7161	30.0979 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984 (71)

Water heating gains (Table 5)

	41.7722	40.4486	37.7001	33.9634	31.5375	28.1216	25.2182	28.9382	30.2600	34.1275	38.4946	40.4542 (72)

Total internal gains

	324.8449	323.5318	312.2400	293.6955	274.1649	255.9307	244.4660	248.1755	258.0406	276.7159	298.1877	314.9655 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.6300	0.7000	0.7700	16.8962	(75)
Southeast	4.3100	36.7938	0.6300	0.7000	0.7700	48.4645	(77)
Southwest	0.8200	36.7938	0.6300	0.7000	0.7700	9.2206	(79)
Northwest	2.2200	11.2829	0.6300	0.7000	0.7700	7.6550	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	82.2365	148.2340	224.4813	314.4503	385.3500	397.1403	376.8194	321.6965	255.2865	169.6706	99.9854	69.4163	(83)
Total gains	407.0814	471.7659	536.7213	608.1458	659.5149	653.0711	621.2853	569.8720	513.3270	446.3865	398.1731	384.3818	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9940	53.1458	53.2954	54.0097	54.1455	54.7866	54.7866	54.9070	54.5379	54.1455	53.8715	53.5881	
alpha	4.5329	4.5431	4.5530	4.6006	4.6097	4.6524	4.6524	4.6605	4.6359	4.6097	4.5914	4.5725	
util living area	0.9986	0.9969	0.9920	0.9740	0.9174	0.7856	0.6261	0.6913	0.9037	0.9856	0.9972	0.9989	(86)
MIT	19.5056	19.6609	19.9328	20.3096	20.6579	20.8932	20.9717	20.9558	20.7703	20.3234	19.8515	19.4842	(87)
Th 2	19.8327	19.8356	19.8385	19.8520	19.8545	19.8663	19.8663	19.8685	19.8618	19.8545	19.8494	19.8441	(88)
util rest of house	0.9980	0.9958	0.9889	0.9629	0.8798	0.6918	0.4825	0.5498	0.8438	0.9776	0.9960	0.9985	(89)
MIT 2	18.4776	18.6347	18.9075	19.2885	19.6163	19.8153	19.8591	19.8555	19.7269	19.3082	18.8362	18.4651	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.7072	18.8639	19.1364	19.5165	19.8489	20.0560	20.1075	20.1012	19.9599	19.5349	19.0629	18.6926	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7072	18.8639	19.1364	19.5165	19.8489	20.0560	20.1075	20.1012	19.9599	19.5349	19.0629	18.6926	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9944	0.9863	0.9587	0.8796	0.7094	0.5150	0.5817	0.8502	0.9745	0.9948	0.9979	(94)
Useful gains	405.9909	469.1471	529.3881	583.0318	580.0909	463.3150	319.9872	331.4786	436.4367	434.9949	396.0842	383.5932	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1393.4914	1346.7565	1215.3090	1007.5412	771.4176	510.4500	328.1543	345.5133	550.7363	845.8243	1138.2255	1386.2193	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	734.7003	589.7535	510.3252	305.6468	142.3471	0.0000	0.0000	0.0000	0.0000	305.6570	534.3417	745.9538	(98)
Space heating												3868.7255	(98)
Space heating per m2											(98) / (4) =	52.4147	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	879.4400	692.3251	709.4775	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8090	0.8816	0.8469	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	711.4498	610.3632	600.8372	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	850.3809	811.4804	752.8987	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	100.0304	149.6312	113.1338	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												362.7954 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	25.0076	37.4078	28.2834	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												90.6988 (107)
Space cooling per m2												1.2288 (108)
Energy for space heating												52.4147 (99)
Energy for space cooling												1.2288 (108)
Total												53.6435 (109)
Target Fabric Energy Efficiency (TFEE)												61.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		4.7800	
Infiltration rate		0.3549	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3283	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3447	0.3201	0.3283	0.3119	0.3119	0.3037	0.2955	0.2873	0.2791	0.3037	0.2873	0.3037	(22b)
Effective ac	0.5594	0.5512	0.5539	0.5486	0.5486	0.5461	0.5437	0.5413	0.5389	0.5461	0.5413	0.5461	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.8496	31.3837	31.5351	31.2360	31.2360	31.0922	30.9522	30.8160	30.6837	31.0922	30.8160	31.0922	(38)
Heat transfer coeff	94.4638	93.9978	94.1493	93.8501	93.8501	93.7063	93.5663	93.4301	93.2978	93.7063	93.4301	93.7063	(39)
Average = Sum(39)m / 12 =												93.7629	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2798	1.2735	1.2756	1.2715	1.2715	1.2696	1.2677	1.2658	1.2640	1.2696	1.2658	1.2696	(40)
HLP (average)												1.2703	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
									Total per year (kWh/year) = Sum(64)m =			1581.8514	(64)
RHI water heating demand												1582	(64)
Heat gains from water heating, kWh/month													
	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains													
	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	14.6176	0.4600	0.0000	0.7700	25.3701	(75)
Southeast	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(77)
Southwest	0.8200	45.1778	0.4600	0.0000	0.7700	13.1216	(79)
Northwest	2.2200	14.6176	0.4600	0.0000	0.7700	11.4942	(81)

Solar gains	118.9545	183.2660	281.7013	399.5538	466.6551	522.6731	491.9682	429.6787	339.3153	226.8870	144.3216	98.6025	(83)
Total gains	645.3444	705.4475	783.6374	870.1618	905.2797	932.6017	885.1002	830.7734	758.4165	677.5211	629.9839	610.6799	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.3677	50.6174	50.5360	50.6971	50.6971	50.7749	50.8508	50.9249	50.9972	50.7749	50.9249	50.7749	
alpha	4.3578	4.3745	4.3691	4.3798	4.3798	4.3850	4.3901	4.3950	4.3998	4.3850	4.3950	4.3850	
util living area													
	0.9861	0.9789	0.9555	0.8900	0.7593	0.5504	0.4073	0.4319	0.6990	0.9090	0.9730	0.9884	(86)
MIT	19.8361	19.9655	20.2502	20.5983	20.8546	20.9725	20.9942	20.9927	20.9239	20.6259	20.1939	19.8190	(87)
Th 2	19.8567	19.8616	19.8600	19.8632	19.8632	19.8648	19.8663	19.8677	19.8691	19.8648	19.8677	19.8648	(88)
util rest of house													
	0.9819	0.9725	0.9416	0.8564	0.6911	0.4504	0.2915	0.3100	0.6013	0.8723	0.9633	0.9847	(89)
MIT 2	18.3548	18.5443	18.9479	19.4243	19.7369	19.8499	19.8646	19.8657	19.8184	19.4743	18.8796	18.3361	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.6856	18.8616	19.2387	19.6864	19.9865	20.1005	20.1168	20.1173	20.0652	19.7314	19.1731	18.6672	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5356	18.7116	19.0887	19.5364	19.8365	19.9505	19.9668	19.9673	19.9152	19.5814	19.0231	18.5172	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9636	0.9295	0.8449	0.6893	0.4583	0.3019	0.3209	0.6057	0.8609	0.9532	0.9784	(94)
Useful gains	629.0992	679.8040	728.3920	735.1715	624.0125	427.3866	267.2482	266.6348	459.3507	583.2569	600.5120	597.5181	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1288.0658	1260.6624	1138.1397	941.9179	688.5295	435.7839	268.2397	267.8927	486.5708	766.6506	1039.2311	1266.6495	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	490.2711	390.3369	304.8523	148.8574	48.0007	0.0000	0.0000	0.0000	0.0000	136.4449	315.8777	497.8337 (98)
Space heating												2332.4748 (98)
RHI space heating demand												2332 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		4.7800	
Infiltration rate		0.3549	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3283	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4186	0.4104	0.4022	0.3611	0.3529	0.3119	0.3119	0.3037	0.3283	0.3529	0.3693	0.3858	(22b)
Effective ac	0.5876	0.5842	0.5809	0.5652	0.5623	0.5486	0.5486	0.5461	0.5539	0.5623	0.5682	0.5744	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.4547	33.2611	33.0712	32.1795	32.0126	31.2360	31.2360	31.0922	31.5351	32.0126	32.3502	32.7030	(38)
Heat transfer coeff	96.0689	95.8752	95.6853	94.7936	94.6268	93.8501	93.8501	93.7063	94.1493	94.6268	94.9643	95.3171	(39)
Average = Sum(39)m / 12 =												94.7928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3016	1.2989	1.2964	1.2843	1.2820	1.2715	1.2715	1.2696	1.2756	1.2820	1.2866	1.2914	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
									Total per year (kWh/year) = Sum(64)m =			1581.8514	(64)
Heat gains from water heating, kWh/month													
	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains													
	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	621.7004	693.9821	762.1059	835.0503	885.2383	870.2072	829.8589	773.9351	714.9737	647.2792	601.5436	592.5297	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.5262	49.6262	49.7247	50.1925	50.2810	50.6971	50.6971	50.7749	50.5360	50.2810	50.1023	49.9168	
alpha	4.3017	4.3084	4.3150	4.3462	4.3521	4.3798	4.3798	4.3850	4.3691	4.3521	4.3402	4.3278	
util living area													
	0.9896	0.9822	0.9646	0.9162	0.8107	0.6414	0.4856	0.5372	0.7728	0.9382	0.9818	0.9914	(86)
MIT	19.7037	19.8698	20.1442	20.4978	20.7865	20.9440	20.9868	20.9798	20.8721	20.5043	20.0413	19.6687	(87)
Th 2	19.8396	19.8417	19.8437	19.8532	19.8549	19.8632	19.8632	19.8648	19.8600	19.8549	19.8513	19.8476	(88)
util rest of house													
	0.9864	0.9768	0.9535	0.8896	0.7535	0.5461	0.3661	0.4141	0.6877	0.9127	0.9753	0.9888	(89)
MIT 2	18.1511	18.3924	18.7867	19.2842	19.6533	19.8270	19.8585	19.8566	19.7624	19.3059	18.6497	18.1060	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.4978	18.7222	19.0898	19.5552	19.9063	20.0764	20.1104	20.1074	20.0102	19.5734	18.9604	18.4549	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3478	18.5722	18.9398	19.4052	19.7563	19.9264	19.9604	19.9574	19.8602	19.4234	18.8104	18.3049	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9805	0.9685	0.9421	0.8769	0.7479	0.5517	0.3766	0.4246	0.6877	0.9002	0.9669	0.9837	(94)
Useful gains	609.5493	672.1492	717.9422	732.2167	662.0501	480.1148	312.5338	328.5762	491.6903	582.7032	581.6116	582.8486	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1349.5551	1310.8290	1190.3064	995.8262	762.3429	499.8823	315.3736	333.3499	542.3149	834.9341	1112.0708	1344.4404	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	550.5643	429.1928	351.4390	189.7988	74.6178	0.0000	0.0000	0.0000	0.0000	187.6598	381.9306	566.6243	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating		2731.8275 (98)
Space heating per m2	(98) / (4) =	37.0116 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3018.5939 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	550.5643	429.1928	351.4390	189.7988	74.6178	0.0000	0.0000	0.0000	0.0000	187.6598	381.9306	566.6243	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	608.3584	474.2462	388.3304	209.7224	82.4506	0.0000	0.0000	0.0000	0.0000	207.3589	422.0228	626.1042	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7559	89.6865	89.5341	89.1765	88.4698	87.3000	87.3000	87.3000	87.3000	89.1387	89.5982	89.7885	(217)
Fuel for water heating, kWh/month	179.2655	157.3464	163.7070	144.8114	141.1942	125.1678	117.6677	132.6356	133.5125	150.3625	161.3412	174.0457	(219)
Water heating fuel used												1781.0577	(219)
Annual totals kWh/year													
Space heating fuel - main system												3018.5939	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	336.0245 (232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =	-1218.5571	-1218.5571 (233)
Total delivered energy for all uses		3992.1190 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3018.5939	3.4800	105.0471	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1781.0577	3.4800	61.9808	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	336.0245	13.1900	44.3216	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			180.5143	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6381 (257)
SAP value		91.0981
SAP rating (Section 12)		91 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3018.5939	0.2160	652.0163	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1781.0577	0.2160	384.7085	(264)
Space and water heating			1036.7247	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			617.6153	(272)
CO2 emissions per m2			8.3700	(273)
EI value			93.0342	
EI rating			93	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band A

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		4.7800	
Infiltration rate		0.3549	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3283	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3447	0.3201	0.3283	0.3119	0.3119	0.3037	0.2955	0.2873	0.2791	0.3037	0.2873	0.3037	(22b)
Effective ac	0.5594	0.5512	0.5539	0.5486	0.5486	0.5461	0.5437	0.5413	0.5389	0.5461	0.5413	0.5461	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.8496	31.3837	31.5351	31.2360	31.2360	31.0922	30.9522	30.8160	30.6837	31.0922	30.8160	31.0922	(38)
Heat transfer coeff	94.4638	93.9978	94.1493	93.8501	93.8501	93.7063	93.5663	93.4301	93.2978	93.7063	93.4301	93.7063	(39)
Average = Sum(39)m / 12 =												93.7629	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2798	1.2735	1.2756	1.2715	1.2715	1.2696	1.2677	1.2658	1.2640	1.2696	1.2658	1.2696	(40)
HLP (average)												1.2703	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
								Total per year (kWh/year) = Sum(64)m =				1581.8514	(64)
Heat gains from water heating, kWh/month	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	14.6176	0.4600	0.0000	0.7700	25.3701	(75)
Southeast	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(77)
Southwest	0.8200	45.1778	0.4600	0.0000	0.7700	13.1216	(79)
Northwest	2.2200	14.6176	0.4600	0.0000	0.7700	11.4942	(81)

Solar gains	118.9545	183.2660	281.7013	399.5538	466.6551	522.6731	491.9682	429.6787	339.3153	226.8870	144.3216	98.6025	(83)
Total gains	645.3444	705.4475	783.6374	870.1618	905.2797	932.6017	885.1002	830.7734	758.4165	677.5211	629.9839	610.6799	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.3677	50.6174	50.5360	50.6971	50.6971	50.7749	50.8508	50.9249	50.9972	50.7749	50.9249	50.7749	
alpha	4.3578	4.3745	4.3691	4.3798	4.3798	4.3850	4.3901	4.3950	4.3998	4.3850	4.3950	4.3850	
util living area	0.9861	0.9789	0.9555	0.8900	0.7593	0.5504	0.4073	0.4319	0.6990	0.9090	0.9730	0.9884	(86)
MIT	19.8361	19.9655	20.2502	20.5983	20.8546	20.9725	20.9942	20.9927	20.9239	20.6259	20.1939	19.8190	(87)
Th 2	19.8567	19.8616	19.8600	19.8632	19.8632	19.8648	19.8663	19.8677	19.8691	19.8648	19.8677	19.8648	(88)
util rest of house	0.9819	0.9725	0.9416	0.8564	0.6911	0.4504	0.2915	0.3100	0.6013	0.8723	0.9633	0.9847	(89)
MIT 2	18.3548	18.5443	18.9479	19.4243	19.7369	19.8499	19.8646	19.8657	19.8184	19.4743	18.8796	18.3361	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.6856	18.8616	19.2387	19.6864	19.9865	20.1005	20.1168	20.1173	20.0652	19.7314	19.1731	18.6672	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5356	18.7116	19.0887	19.5364	19.8365	19.9505	19.9668	19.9673	19.9152	19.5814	19.0231	18.5172	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9636	0.9295	0.8449	0.6893	0.4583	0.3019	0.3209	0.6057	0.8609	0.9532	0.9784	(94)
Useful gains	629.0992	679.8040	728.3920	735.1715	624.0125	427.3866	267.2482	266.6348	459.3507	583.2569	600.5120	597.5181	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1288.0658	1260.6624	1138.1397	941.9179	688.5295	435.7839	268.2397	267.8927	486.5708	766.6506	1039.2311	1266.6495	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	490.2711	390.3369	304.8523	148.8574	48.0007	0.0000	0.0000	0.0000	0.0000	136.4449	315.8777	497.8337	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating			2332.4748 (98)
Space heating per m2		(98) / (4) =	31.6011 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2577.3202	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	490.2711	390.3369	304.8523	148.8574	48.0007	0.0000	0.0000	0.0000	0.0000	136.4449	315.8777	497.8337	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	541.7361	431.3115	336.8534	164.4833	53.0394	0.0000	0.0000	0.0000	0.0000	150.7679	349.0362	550.0925	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6877	89.6276	89.4356	88.9848	88.1654	87.3000	87.3000	87.3000	87.3000	88.8855	89.4703	89.7143	(217)
Fuel for water heating, kWh/month													
	179.4020	157.4498	163.8874	145.1233	141.6818	125.1678	117.6677	132.6356	133.5125	150.7907	161.5718	174.1896	(219)
Water heating fuel used												1783.0802	(219)
Annual totals kWh/year													
Space heating fuel - main system												2577.3202	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3402.4477	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2577.3202	10.2300	263.6599	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1783.0802	10.2300	182.4091	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	336.0245	36.7200	123.3882	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			197.3087	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2577.3202	0.2160	556.7012	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1783.0802	0.2160	385.1453	(264)
Space and water heating			941.8465	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			444.6691	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2577.3202	1.2200	3144.3307	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1783.0802	1.2200	2175.3578	(264)
Space and water heating			5319.6885	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	336.0245	3.0700	1031.5951	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			2378.7738 (272)
Primary energy kWh/m2/year			32.2283 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£151	£151	£0
Mains gas	£549	£549	£0
Space heating	£394	£394	£0
Water heating	£182	£182	£0
Lighting	£123	£123	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£197	£197	£0
Total cost of uses	£196	£196	£0
Delivered energy	46 kWh/m²	46 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.4 tonnes	0.0 tonnes
CO2 emissions per m²	6 kg/m²	6 kg/m²	0 kg/m²
Primary energy	32 kWh/m²	32 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	232.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	227.73 (P1)
Transmission heat loss coefficient	62.61 (37)
Summer heat loss coefficient	290.35 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.9000	106.0502	0.4600	0.0000	0.9000	215.1335
South East	4.3100	127.3119	0.4600	0.0000	0.9000	227.1676
South West	0.8200	127.3119	0.4600	0.0000	0.9000	43.2198
North West	2.2200	106.0502	0.4600	0.0000	0.9000	97.4686
total:						582.9896

	Jun	Jul	Aug	
Solar gains	630	583	508	(P4)
Internal gains	407	390	398	
Total summer gains	1037	973	906	(P5)
Summer gain/loss ratio	3.57	3.35	3.12	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 232.1)	0.38	0.38	0.38	
Threshold temperature	19.35	21.03	20.79	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-342.R	**Issued on Date**	04/10/2023
Assessment Reference	As Built	**Prop Type Ref**	2BMW-As-DET
Property	14, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	92 A	**DER**	8.72	**TER**	19.16
Environmental	94 A	**% DER<TER**	54.49		
CO_2 Emissions (t/year)	0.36	**DFEE**	45.49	**TFEE**	56.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.83		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached Maisonette, total floor area 77 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.16 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.72 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.48 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Medium OK
Based on:
Overshading: Average
Windows facing North: 1.04 m², No overhang
Windows facing North East: 0.82 m², No overhang
Windows facing South East: 2.61 m², No overhang
Windows facing South West: 3.40 m², No overhang
Windows facing West: 1.04 m², No overhang
Windows facing North West: 7.32 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3094	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3945	0.3867	0.3790	0.3403	0.3326	0.2939	0.2939	0.2862	0.3094	0.3326	0.3481	0.3635	(22b)
Effective ac	0.5778	0.5748	0.5718	0.5579	0.5553	0.5432	0.5432	0.5409	0.5479	0.5553	0.5606	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.5208	34.3403	34.1634	33.3324	33.1769	32.4531	32.4531	32.3191	32.7319	33.1769	33.4914	33.8203	(38)
Heat transfer coeff	92.5030	92.3225	92.1455	91.3145	91.1591	90.4353	90.4353	90.3013	90.7141	91.1591	91.4736	91.8024	(39)
Average = Sum(39)m / 12 =												91.3138	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1956	1.1933	1.1910	1.1802	1.1782	1.1689	1.1689	1.1671	1.1725	1.1782	1.1823	1.1865	(40)
HLP (average)												1.1802	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4111 (42)
Average daily hot water use (litres/day)		91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

Distribution loss (46)m = 0.15 x (45)m

	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Total heat required for water heating calculated for each month

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)
								Total per year (kWh/year) = Sum(64)m =				1610.4406 (64)

Heat gains from water heating, kWh/month

	53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426 (71)

Water heating gains (Table 5)

	71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978 (72)

Total internal gains

	366.7479	364.7074	351.5420	330.3002	308.7478	287.9393	274.3916	280.2631	291.1445	312.5951	337.2538	355.7347 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.4600	0.0000	0.7700	3.9170	(74)
Northeast	0.8200	11.2829	0.4600	0.0000	0.7700	3.2771	(75)
Southeast	2.6100	36.7938	0.4600	0.0000	0.7700	34.0145	(77)
Southwest	3.4000	36.7938	0.4600	0.0000	0.7700	44.3101	(79)
West	1.0400	19.6403	0.4600	0.0000	0.7700	7.2348	(80)
Northwest	2.8100	11.2829	0.4600	0.0000	0.7700	11.2299	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	122.0073	221.2717	337.8757	476.5362	585.8934	604.3991	573.2548	488.3175	385.4315	254.0800	148.6001	102.8108	(83)
Total gains	488.7551	585.9790	689.4177	806.8364	894.6412	892.3384	847.6464	768.5806	676.5760	566.6751	485.8539	458.5455	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.0725	60.1899	60.3055	60.8543	60.9581	61.4460	61.4460	61.5372	61.2571	60.9581	60.7485	60.5309	
alpha	5.0048	5.0127	5.0204	5.0570	5.0639	5.0964	5.0964	5.1025	5.0838	5.0639	5.0499	5.0354	
util living area	0.9978	0.9943	0.9822	0.9354	0.8118	0.6216	0.4641	0.5294	0.8015	0.9689	0.9952	0.9984	(86)
MIT	19.7607	19.9400	20.2268	20.5883	20.8571	20.9716	20.9947	20.9900	20.9015	20.5308	20.0740	19.7266	(87)
Th 2	19.9235	19.9254	19.9272	19.9358	19.9375	19.9450	19.9450	19.9464	19.9421	19.9375	19.9342	19.9308	(88)
util rest of house	0.9971	0.9923	0.9758	0.9125	0.7544	0.5305	0.3557	0.4139	0.7199	0.9535	0.9932	0.9979	(89)
MIT 2	18.2787	18.5413	18.9571	19.4684	19.8066	19.9278	19.9432	19.9427	19.8682	19.4020	18.7441	18.2340	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	18.5944	18.8392	19.2275	19.7069	20.0304	20.1501	20.1672	20.1658	20.0883	19.6424	19.0274	18.5520	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4444	18.6892	19.0775	19.5569	19.8804	20.0001	20.0172	20.0158	19.9383	19.4924	18.8774	18.4020	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9889	0.9688	0.9024	0.7510	0.5355	0.3632	0.4217	0.7196	0.9446	0.9901	0.9966	(94)
Useful gains	486.5326	579.4469	667.8883	728.0743	671.8628	477.8520	307.8842	324.1141	486.8500	535.2663	481.0326	457.0010	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1308.3955	1273.0542	1158.9619	973.1298	745.7162	488.3605	309.0342	326.5072	529.6125	810.6251	1077.3179	1303.7742	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	611.4660	466.1041	365.3588	176.4400	54.9469	0.0000	0.0000	0.0000	0.0000	204.8669	429.3254	629.9993	(98)
Space heating												2938.5075	(98)
Space heating per m2											(98) / (4) =	37.9799	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3246.9696	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	611.4660	466.1041	365.3588	176.4400	54.9469	0.0000	0.0000	0.0000	0.0000	204.8669	429.3254	629.9993	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	675.6531	515.0322	403.7114	194.9613	60.7148	0.0000	0.0000	0.0000	0.0000	226.3723	474.3927	696.1318	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8043	89.7249	89.5480	89.1054	88.2415	87.3000	87.3000	87.3000	87.3000	89.1930	89.6609	89.8359	(217)
Fuel for water heating, kWh/month													
	182.4688	160.1697	166.6697	147.5443	144.0952	127.3789	119.7166	134.9873	135.8928	152.9866	164.1781	177.1484	(219)
Water heating fuel used												1813.2366	(219)
Annual totals kWh/year													
Space heating fuel - main system												3246.9696	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4254.3001	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3246.9696	0.2160	701.3454	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1813.2366	0.2160	391.6591	(264)
Space and water heating			1093.0045	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			674.7393	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.7200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		8.7200	ZC1
Total Floor Area	TFA	77.3700	
Assumed number of occupants	N	2.4111	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3793	ZC2
CO2 emissions from cooking, equation (L16)		2.2860	ZC3
Total CO2 emissions		27.3853	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.3853	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1657	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4157	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3845	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4903	0.4807	0.4710	0.4230	0.4134	0.3653	0.3653	0.3557	0.3845	0.4134	0.4326	0.4518	(22b)
Effective ac	0.6202	0.6155	0.6109	0.5895	0.5854	0.5667	0.5667	0.5633	0.5739	0.5854	0.5936	0.6021	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			16.2300	1.3258	21.5170			(27)
GF B&B J150 P/A=0.50			77.3700	0.1300	10.0581			(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.1800	12.2652			(29a)
Bay	1.0400		1.0400	0.1300	0.1352			(30)
Ceiling to void	10.8400		10.8400	0.1300	1.4092			(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.5147			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2107	(36)
Total fabric heat loss					(33) + (36) =		59.7254	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.0529	36.7741	36.5008	35.2171	34.9769	33.8589	33.8589	33.6518	34.2895	34.9769	35.4628	35.9707	(38)
Heat transfer coeff	96.7783	96.4995	96.2262	94.9425	94.7024	93.5843	93.5843	93.3773	94.0150	94.7024	95.1882	95.6962	(39)
Average = Sum(39)m / 12 =												94.9414	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2472	1.2437	1.2271	1.2240	1.2096	1.2096	1.2069	1.2151	1.2240	1.2303	1.2369	(40)
HLP (average)												1.2271	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4111	(42)
Average daily hot water use (litres/day)												91.4628	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	44.6238	47.5406	44.2028	43.8119	40.5944	41.9476	43.8119	44.2028	47.5406	47.8112	50.9589	(61)
Total heat required for water heating calculated for each month													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(64)
								Total per year (kWh/year) = Sum(64)m =				1987.0714	(64)
Heat gains from water heating, kWh/month													
	62.3488	54.5444	56.6581	50.0849	48.4072	42.4688	40.4363	45.3203	45.8285	52.4153	56.1946	60.7835	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	(71)
Water heating gains (Table 5)													
	83.8022	81.1673	76.1534	69.5623	65.0634	58.9844	54.3498	60.9144	63.6507	70.4507	78.0481	81.6983	(72)
Total internal gains													
	378.9436	376.3901	362.6128	340.7616	318.5948	297.1741	283.6350	290.1181	301.6178	323.6780	348.9434	367.9351	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.6300	0.7000	0.7700	3.3797	(74)
Northeast	0.8200	11.2829	0.6300	0.7000	0.7700	2.8275	(75)
Southeast	2.6100	36.7938	0.6300	0.7000	0.7700	29.3486	(77)
Southwest	3.4000	36.7938	0.6300	0.7000	0.7700	38.2319	(79)
West	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424	(80)
Northwest	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(81)

Solar gains	105.2710	190.9190	291.5280	411.1679	505.5241	521.4913	494.6192	421.3331	332.5604	219.2269	128.2161	88.7079	(83)
Total gains	484.2146	567.3091	654.1408	751.9295	824.1189	818.6654	778.2541	711.4512	634.1782	542.9048	477.1594	456.6430	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5178	55.6782	55.8363	56.5913	56.7348	57.4126	57.4126	57.5399	57.1496	56.7348	56.4452	56.1456	
alpha	4.7012	4.7119	4.7224	4.7728	4.7823	4.8275	4.8275	4.8360	4.8100	4.7823	4.7630	4.7430	
util living area													
	0.9976	0.9945	0.9850	0.9500	0.8533	0.6798	0.5173	0.5817	0.8371	0.9731	0.9950	0.9982	(86)
MIT	19.6493	19.8198	20.1037	20.4799	20.7874	20.9491	20.9890	20.9812	20.8587	20.4531	19.9851	19.6236	(87)
Th 2	19.8795	19.8824	19.8852	19.8984	19.9008	19.9124	19.9124	19.9145	19.9079	19.9008	19.8958	19.8906	(88)
util rest of house													
	0.9967	0.9926	0.9795	0.9313	0.8016	0.5846	0.3955	0.4553	0.7607	0.9596	0.9930	0.9975	(89)
MIT 2	18.0899	18.3404	18.7537	19.2953	19.6974	19.8797	19.9085	19.9070	19.7961	19.2696	18.5918	18.0599	(90)
Living area fraction										fLA = Living area / (4) =		0.2130	(91)
MIT	18.4220	18.6555	19.0413	19.5476	19.9295	20.1074	20.1386	20.1358	20.0225	19.5217	18.8886	18.3930	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4220	18.6555	19.0413	19.5476	19.9295	20.1074	20.1386	20.1358	20.0225	19.5217	18.8886	18.3930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9895	0.9738	0.9238	0.8032	0.6028	0.4215	0.4822	0.7700	0.9533	0.9901	0.9962	(94)
Useful gains	481.8284	561.3451	637.0109	694.6439	661.9183	493.4783	328.0630	343.0881	488.3101	517.5333	472.4559	454.9166	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1366.7071	1327.3991	1206.8005	1010.9144	779.3574	515.4101	331.1597	348.8417	556.8000	844.9070	1122.1332	1358.2130	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	658.3498	514.7883	423.9235	227.7147	87.3747	0.0000	0.0000	0.0000	0.0000	243.5660	467.7677	672.0525	(98)
Space heating												3295.5372	(98)
Space heating per m2											(98) / (4) =	42.5945	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3528.4124	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	658.3498	514.7883	423.9235	227.7147	87.3747	0.0000	0.0000	0.0000	0.0000	243.5660	467.7677	672.0525	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	704.8713	551.1652	453.8796	243.8059	93.5489	0.0000	0.0000	0.0000	0.0000	260.7773	500.8219	719.5423	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8246	87.6032	87.1066	85.9145	83.6490	80.3000	80.3000	80.3000	80.3000	85.9642	87.3369	87.9088	(217)
Fuel for water heating, kWh/month													
	227.9081	199.8961	209.1645	188.0927	187.0390	171.6038	164.4096	183.2781	185.3022	197.1006	207.0940	222.3343	(219)
Water heating fuel used												2343.2230	(219)
Annual totals kWh/year													
Space heating fuel - main system												3528.4124	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Total delivered energy for all uses												6284.2865	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3528.4124	0.2160	762.1371	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2343.2230	0.2160	506.1362	(264)
Space and water heating			1268.2733	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Total CO2, kg/m2/year			1482.4391	(272)
Emissions per m2 for space and water heating			16.3923	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2650	(272b)
Emissions per m2 for pumps and fans			0.5031	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3923 * 1.00) + 2.2650 + 0.5031, rounded to 2 d.p.			19.1600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1657	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3897	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3605	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4596	0.4506	0.4416	0.3965	0.3875	0.3425	0.3425	0.3334	0.3605	0.3875	0.4055	0.4236	(22b)
Effective ac	0.6056	0.6015	0.5975	0.5786	0.5751	0.5586	0.5586	0.5556	0.5650	0.5751	0.5822	0.5897	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			30.0000	2289.9000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16951.5820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		219.0976 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.1828	35.9378	35.6976	34.5695	34.3584	33.3758	33.3758	33.1939	33.7543	34.3584	34.7854	35.2318	(38)
Heat transfer coeff	94.1650	93.9199	93.6797	92.5516	92.3405	91.3580	91.3580	91.1760	91.7365	92.3405	92.7675	93.2139	(39)
Average = Sum(39)m / 12 =												92.5506	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2171	1.2139	1.2108	1.1962	1.1935	1.1808	1.1808	1.1784	1.1857	1.1935	1.1990	1.2048	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (46)
Water storage loss:
Total storage loss
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Primary loss    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (59)
Heat gains from water heating, kWh/month
               31.7051   27.7295   28.6143   24.9467   23.9369   20.6557   19.1406   21.9641   22.2264   25.9027   28.2749   30.7047 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m         120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               19.1192   16.9815   13.8103   10.4553    7.8154    6.5981    7.1295    9.2672   12.4384   15.7934   18.4333   19.6506 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              213.8562  216.0754  210.4832  198.5780  183.5499  169.4256  159.9897  157.7705  163.3627  175.2679  190.2960  204.4203 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553 (69)
Pumps, fans     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426 (71)
Water heating gains (Table 5)
               42.6143   41.2641   38.4601   34.6481   32.1733   28.6885   25.7266   29.5216   30.8700   34.8155   39.2706   41.2697 (72)
Total internal gains
              334.7557  333.4869  321.9195  302.8474  282.7046  263.8782  252.0117  255.7253  265.8371  285.0428  307.1659  324.5066 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a      Specific data       Specific data      factor             W
                                                         W/m2      or Table 6b         or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------------------------
North                                  1.0400            10.6334          0.4600             0.0000          0.7700          3.9170 (74)
Northeast                              0.8200            11.2829          0.4600             0.0000          0.7700          3.2771 (75)
Southeast                              2.6100            36.7938          0.4600             0.0000          0.7700         34.0145 (77)
Southwest                              3.4000            36.7938          0.4600             0.0000          0.7700         44.3101 (79)
West                                   1.0400            19.6403          0.4600             0.0000          0.7700          7.2348 (80)
Northwest                              2.8100            11.2829          0.4600             0.0000          0.7700         11.2299 (81)
Northwest                              4.5100            11.2829          0.4600             0.0000          0.7700         18.0238 (81)
-------------------------------------------------------------------------------------------------------------------

Solar gains   122.0073  221.2717  337.8757  476.5362  585.8934  604.3991  573.2548  488.3175  385.4315  254.0800  148.6001  102.8108 (83)
Total gains   456.7630  554.7586  659.7952  779.3836  868.5980  868.2773  825.2665  744.0428  651.2687  539.1228  455.7660  427.3174 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           50.0056   50.1360   50.2646   50.8773   50.9936   51.5420   51.5420   51.6449   51.3294   50.9936   50.7588   50.5158
alpha          4.3337    4.3424    4.3510    4.3918    4.3996    4.4361    4.4361    4.4430    4.4220    4.3996    4.3839    4.3677
util living area
                0.9967    0.9918    0.9773    0.9279    0.8101    0.6303    0.4766    0.5435    0.8038    0.9638    0.9932    0.9975 (86)

MIT            19.5169   19.7224   20.0517   20.4713   20.7932   20.9500   20.9884   20.9799   20.8537   20.4122   19.8853   19.4835 (87)
Th 2           19.9064   19.9089   19.9114   19.9230   19.9252   19.9354   19.9354   19.9373   19.9315   19.9252   19.9208   19.9162 (88)
util rest of house
                0.9956    0.9894    0.9702    0.9055    0.7564    0.5415    0.3664    0.4274    0.7277    0.9482    0.9907    0.9967 (89)
MIT 2          18.5594   18.7656   19.0924   19.5039   19.7885   19.9123   19.9323   19.9313   19.8499   19.4586   18.9379   18.5336 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.2130 (91)
MIT            18.7633   18.9694   19.2967   19.7100   20.0025   20.1334   20.1572   20.1546   20.0638   19.6617   19.1397   18.7359 (92)
Temperature adjustment                                                                                                    0.0000
adjusted MIT   18.7633   18.9694   19.2967   19.7100   20.0025   20.1334   20.1572   20.1546   20.0638   19.6617   19.1397   18.7359 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------------------

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9941    0.9865    0.9651    0.9003    0.7607    0.5589    0.3899    0.4521    0.7384    0.9433    0.9883    0.9956 (94)
Useful gains  454.0878  547.2578  636.7781  701.6415  660.7150  485.2800  321.8079  336.3733  480.8653  508.5531  450.4206  425.4202 (95)
Ext temp.       4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
             1361.9392 1321.3991 1198.7962 1000.4789  766.6555  505.5158  324.9832  342.3327  547.0937  836.7645 1116.8949 1354.9519 (97)
Month fracti    1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
              675.4414  520.2230  418.1414  215.1629   78.8197    0.0000    0.0000    0.0000    0.0000  244.1893  479.8615  691.5716 (98)
Space heating                                                                                                          3323.4108 (98)
Space heating per m2                                                                                    (98) / (4) =     42.9548 (99)


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8c. Space cooling requirement
-------------------------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.7650	676.0491	692.9378	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9023	0.9448	0.9211	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	774.8471	638.7497	638.2337	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1104.5971	1052.4777	959.0275	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	237.4200	307.8136	238.6706	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												783.9042	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	59.3550	76.9534	59.6676	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												195.9761	(107)
Space cooling per m2												2.5330	(108)
Energy for space heating												42.9548	(99)
Energy for space cooling												2.5330	(108)
Total												45.4877	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1657	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4157	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3845	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4903	0.4807	0.4710	0.4230	0.4134	0.3653	0.3653	0.3557	0.3845	0.4134	0.4326	0.4518	(22b)
Effective ac	0.6202	0.6155	0.6109	0.5895	0.5854	0.5667	0.5667	0.5633	0.5739	0.5854	0.5936	0.6021	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			16.2300	1.3258	21.5170			(27)
GF B&B J150 P/A=0.50			77.3700	0.1300	10.0581			(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.1800	12.2652			(29a)
Bay	1.0400		1.0400	0.1300	0.1352			(30)
Ceiling to void	10.8400		10.8400	0.1300	1.4092			(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.5147			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2107	(36)
Total fabric heat loss					(33) + (36) =		59.7254	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.0529	36.7741	36.5008	35.2171	34.9769	33.8589	33.8589	33.6518	34.2895	34.9769	35.4628	35.9707	(38)
Heat transfer coeff	96.7783	96.4995	96.2262	94.9425	94.7024	93.5843	93.5843	93.3773	94.0150	94.7024	95.1882	95.6962	(39)
Average = Sum(39)m / 12 =												94.9414	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2472	1.2437	1.2271	1.2240	1.2096	1.2096	1.2069	1.2151	1.2240	1.2303	1.2369	(40)
HLP (average)												1.2271	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4111	(42)
Average daily hot water use (litres/day)												91.4628	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	31.7051	27.7295	28.6143	24.9467	23.9369	20.6557	19.1406	21.9641	22.2264	25.9027	28.2749	30.7047	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	(71)
Water heating gains (Table 5)													
	42.6143	41.2641	38.4601	34.6481	32.1733	28.6885	25.7266	29.5216	30.8700	34.8155	39.2706	41.2697	(72)
Total internal gains													
	334.7557	333.4869	321.9195	302.8474	282.7046	263.8782	252.0117	255.7253	265.8371	285.0428	307.1659	324.5066	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.6300	0.7000	0.7700	3.3797	(74)
Northeast	0.8200	11.2829	0.6300	0.7000	0.7700	2.8275	(75)
Southeast	2.6100	36.7938	0.6300	0.7000	0.7700	29.3486	(77)
Southwest	3.4000	36.7938	0.6300	0.7000	0.7700	38.2319	(79)
West	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424	(80)
Northwest	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	105.2710	190.9190	291.5280	411.1679	505.5241	521.4913	494.6192	421.3331	332.5604	219.2269	128.2161	88.7079	(83)
Total gains	440.0268	524.4059	613.4475	714.0153	788.2287	785.3695	746.6309	677.0584	598.3975	504.2697	435.3819	413.2144	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5178	55.6782	55.8363	56.5913	56.7348	57.4126	57.4126	57.5399	57.1496	56.7348	56.4452	56.1456	
alpha	4.7012	4.7119	4.7224	4.7728	4.7823	4.8275	4.8275	4.8360	4.8100	4.7823	4.7630	4.7430	
util living area													
	0.9984	0.9960	0.9883	0.9582	0.8695	0.7010	0.5371	0.6068	0.8595	0.9797	0.9966	0.9988	(86)
MIT	19.5972	19.7699	20.0584	20.4438	20.7660	20.9419	20.9871	20.9775	20.8388	20.4121	19.9362	19.5721	(87)
Th 2	19.8795	19.8824	19.8852	19.8984	19.9008	19.9124	19.9124	19.9145	19.9079	19.9008	19.8958	19.8906	(88)
util rest of house													
	0.9978	0.9946	0.9840	0.9420	0.8209	0.6056	0.4117	0.4771	0.7879	0.9691	0.9952	0.9984	(89)
MIT 2	18.6057	18.7801	19.0684	19.4535	19.7456	19.8865	19.9092	19.9083	19.8185	19.4312	18.9570	18.5893	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	18.8169	18.9909	19.2793	19.6645	19.9630	20.1113	20.1388	20.1360	20.0358	19.6401	19.1656	18.7987	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8169	18.9909	19.2793	19.6645	19.9630	20.1113	20.1388	20.1360	20.0358	19.6401	19.1656	18.7987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9931	0.9809	0.9377	0.8240	0.6243	0.4386	0.5049	0.7978	0.9657	0.9939	0.9978	(94)
Useful gains	438.7365	520.7734	601.7077	669.5498	649.5325	490.3180	327.5031	341.8672	477.3841	486.9711	432.7086	412.3127	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1404.9208	1359.7651	1229.7000	1022.0057	782.5224	515.7675	331.1756	348.8604	558.0552	856.1199	1148.5026	1397.0370	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	718.8411	563.8024	467.2262	253.7683	98.9445	0.0000	0.0000	0.0000	0.0000	274.6467	515.3717	732.6349	(98)
Space heating												3625.2357	(98)
Space heating per m2											(98) / (4) =	46.8558	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	879.6926	692.5239	709.6672	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8795	0.9325	0.9046	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	773.6460	645.7489	641.9613	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.6919	960.5660	880.7340	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000   168.5131   234.2239   177.6469     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          580.3839 (104)
Cooled fraction                                                                                        fC = cooled area / (4) =          1.0000 (105)
Intermittency factor (Table 10b)
              0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000    42.1283    58.5560    44.4117     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          145.0960 (107)
Space cooling per m2                                                                                                                     1.8754 (108)
Energy for space heating                                                                                                                46.8558 (99)
Energy for space cooling                                                                                                                 1.8754 (108)
Total                                                                                                                                   48.7312 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  56.0 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3094	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3249	0.3016	0.3094	0.2939	0.2939	0.2862	0.2784	0.2707	0.2630	0.2862	0.2707	0.2862	(22b)
Effective ac	0.5528	0.5455	0.5479	0.5432	0.5432	0.5409	0.5388	0.5366	0.5346	0.5409	0.5366	0.5409	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.0250	32.5907	32.7319	32.4531	32.4531	32.3191	32.1886	32.0618	31.9384	32.3191	32.0618	32.3191	(38)
Heat transfer coeff	91.0072	90.5729	90.7141	90.4353	90.4353	90.3013	90.1708	90.0439	89.9206	90.3013	90.0439	90.3013	(39)
Average = Sum(39)m / 12 =												90.3540	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1763	1.1706	1.1725	1.1689	1.1689	1.1671	1.1654	1.1638	1.1622	1.1671	1.1638	1.1671	(40)
HLP (average)												1.1678	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4111 (42)
Average daily hot water use (litres/day)		91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Total heat required for water heating calculated for each month

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)
								Total per year (kWh/year) = Sum(64)m =				1610.4406 (64)

RHI water heating demand 1610 (64)

Heat gains from water heating, kWh/month

	53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	47.7980	42.4538	34.5257	26.1382	19.5386	16.4953	17.8238	23.1680	31.0960	39.4836	46.0832	49.1265 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	319.1884	322.5005	314.1540	296.3851	273.9551	252.8740	238.7906	235.4784	243.8250	261.5939	284.0239	305.1049 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426 (71)

Water heating gains (Table 5)

	71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978 (72)

Total internal gains

	541.6916	537.5376	516.8610	484.7229	451.8089	422.2177	404.8195	412.8046	431.1971	463.5440	499.5643	526.8279 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	13.4839	0.4600	0.0000	0.7700	4.9670	(74)
Northeast	0.8200	14.6176	0.4600	0.0000	0.7700	4.2456	(75)
Southeast	2.6100	45.1778	0.4600	0.0000	0.7700	41.7652	(77)
Southwest	3.4000	45.1778	0.4600	0.0000	0.7700	54.4068	(79)
West	1.0400	25.1925	0.4600	0.0000	0.7700	9.2801	(80)
Northwest	2.8100	14.6176	0.4600	0.0000	0.7700	14.5490	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	152.5645	236.5001	366.4578	523.0177	612.5522	686.6100	646.0806	563.2491	442.6764	293.7129	185.4295	126.2403 (83)
Total gains	694.2561	774.0377	883.3188	1007.7406	1064.3612	1108.8277	1050.9001	976.0537	873.8735	757.2569	684.9938	653.0682 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.0599	61.3526	61.2571	61.4460	61.4460	61.5372	61.6262	61.7130	61.7977	61.5372	61.7130	61.5372	
alpha	5.0707	5.0902	5.0838	5.0964	5.0964	5.1025	5.1084	5.1142	5.1198	5.1025	5.1142	5.1025	
util living area	0.9879	0.9789	0.9460	0.8489	0.6779	0.4592	0.3338	0.3585	0.6216	0.8871	0.9730	0.9904	(86)
MIT	20.0832	20.2177	20.4887	20.7826	20.9445	20.9935	20.9990	20.9986	20.9725	20.7701	20.3951	20.0597	(87)
Th 2	19.9390	19.9436	19.9421	19.9450	19.9450	19.9464	19.9477	19.9491	19.9503	19.9464	19.9491	19.9464	(88)
util rest of house	0.9840	0.9721	0.9292	0.8078	0.6086	0.3767	0.2442	0.2626	0.5294	0.8440	0.9627	0.9871	(89)
MIT 2	18.7579	18.9538	19.3330	19.7197	19.9009	19.9432	19.9475	19.9487	19.9339	19.7174	19.2143	18.7297	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	19.0402	19.2230	19.5791	19.9461	20.1232	20.1669	20.1715	20.1723	20.1552	19.9417	19.4658	19.0130	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8902	19.0730	19.4291	19.7961	19.9732	20.0169	20.0215	20.0223	20.0052	19.7917	19.3158	18.8630	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9646	0.9190	0.8012	0.6105	0.3823	0.2505	0.2694	0.5344	0.8364	0.9543	0.9824	(94)
Useful gains	679.2994	746.6608	811.8045	807.4362	649.8352	423.9486	263.2620	262.9027	467.0300	633.3841	653.7080	641.5596	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1273.2056	1247.4625	1127.4975	931.1326	675.8410	425.9437	263.4302	263.1384	477.0433	757.7769	1027.9225	1251.8456	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	441.8662	336.5387	234.8756	89.0614	19.3483	0.0000	0.0000	0.0000	0.0000	92.5483	269.4345	454.0528	(98)
Space heating												1937.7258	(98)
RHI space heating demand												1938	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3094	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3945	0.3867	0.3790	0.3403	0.3326	0.2939	0.2939	0.2862	0.3094	0.3326	0.3481	0.3635	(22b)
Effective ac	0.5778	0.5748	0.5718	0.5579	0.5553	0.5432	0.5432	0.5409	0.5479	0.5553	0.5606	0.5661	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.5208	34.3403	34.1634	33.3324	33.1769	32.4531	32.4531	32.3191	32.7319	33.1769	33.4914	33.8203	(38)
Heat transfer coeff	92.5030	92.3225	92.1455	91.3145	91.1591	90.4353	90.4353	90.3013	90.7141	91.1591	91.4736	91.8024	(39)
Average = Sum(39)m / 12 =												91.3138	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1956	1.1933	1.1910	1.1802	1.1782	1.1689	1.1689	1.1671	1.1725	1.1782	1.1823	1.1865	(40)
HLP (average)												1.1802	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Combi loss

Total heat required for water heating calculated for each month

163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)

Total per year (kWh/year) = Sum(64)m = 1610.4406 (64)

Heat gains from water heating, kWh/month

53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

47.7980	42.4538	34.5257	26.1382	19.5386	16.4953	17.8238	23.1680	31.0960	39.4836	46.0832	49.1265	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

319.1884	322.5005	314.1540	296.3851	273.9551	252.8740	238.7906	235.4784	243.8250	261.5939	284.0239	305.1049	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	(69)
3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Pumps, fans

Losses e.g. evaporation (negative values) (Table 5)

-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	(71)

Water heating gains (Table 5)

71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978	(72)

Total internal gains

541.6916	537.5376	516.8610	484.7229	451.8089	422.2177	404.8195	412.8046	431.1971	463.5440	499.5643	526.8279	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.4600	0.0000	0.7700	3.9170	(74)
Northeast	0.8200	11.2829	0.4600	0.0000	0.7700	3.2771	(75)
Southeast	2.6100	36.7938	0.4600	0.0000	0.7700	34.0145	(77)
Southwest	3.4000	36.7938	0.4600	0.0000	0.7700	44.3101	(79)
West	1.0400	19.6403	0.4600	0.0000	0.7700	7.2348	(80)
Northwest	2.8100	11.2829	0.4600	0.0000	0.7700	11.2299	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	122.0073	221.2717	337.8757	476.5362	585.8934	604.3991	573.2548	488.3175	385.4315	254.0800	148.6001	102.8108	(83)
Total gains	663.6989	758.8092	854.7367	961.2592	1037.7023	1026.6168	978.0743	901.1221	816.6286	717.6240	648.1645	629.6388	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.0725	60.1899	60.3055	60.8543	60.9581	61.4460	61.4460	61.5372	61.2571	60.9581	60.7485	60.5309	
alpha	5.0048	5.0127	5.0204	5.0570	5.0639	5.0964	5.0964	5.1025	5.0838	5.0639	5.0499	5.0354	

util living area

0.9916	0.9829	0.9590	0.8872	0.7409	0.5501	0.4044	0.4561	0.7087	0.9272	0.9834	0.9935	(86)

MIT	19.9605	20.1314	20.3940	20.7037	20.9072	20.9835	20.9971	20.9949	20.9445	20.6676	20.2549	19.9235	(87)
Th 2	19.9235	19.9254	19.9272	19.9358	19.9375	19.9450	19.9450	19.9464	19.9421	19.9375	19.9342	19.9308	(88)

util rest of house

0.9889	0.9774	0.9459	0.8540	0.6784	0.4654	0.3087	0.3542	0.6217	0.8975	0.9771	0.9913	(89)
18.5689	18.8165	19.1904	19.6141	19.8566	19.9354	19.9441	19.9446	19.9037	19.5807	19.0036	18.5206	(90)

MIT 2

Living area fraction fLA = Living area / (4) = 0.2130 (91)

MIT	18.8653	19.0966	19.4467	19.8462	20.0804	20.1586	20.1684	20.1683	20.1254	19.8122	19.2701	18.8194	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7153	18.9466	19.2967	19.6962	19.9304	20.0086	20.0184	20.0183	19.9754	19.6622	19.1201	18.6694	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9706	0.9361	0.8453	0.6780	0.4707	0.3155	0.3613	0.6247	0.8879	0.9703	0.9876	(94)
Useful gains	653.3942	736.4716	800.1099	812.5164	703.5143	483.2134	308.5449	325.5568	510.1238	637.1591	628.9301	621.8341	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

1333.4585	1296.8125	1179.1627	985.8499	750.2748	489.1315	309.1423	326.7355	532.9815	826.1004	1099.5224	1328.3255	(97)
1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Month fracti

Space heating kWh

505.9679	376.5491	282.0152	124.8002	34.7899	0.0000	0.0000	0.0000	0.0000	140.5723	338.8265	525.6296	(98)

Space heating 2329.1507 (98)

Space heating per m2 (98) / (4) = 30.1041 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2573.6472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	505.9679	376.5491	282.0152	124.8002	34.7899	0.0000	0.0000	0.0000	0.0000	140.5723	338.8265	525.6296	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	559.0805	416.0764	311.6190	137.9008	38.4418	0.0000	0.0000	0.0000	0.0000	155.3286	374.3939	580.8062	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6957	89.5928	89.3664	88.8296	87.9682	87.3000	87.3000	87.3000	87.3000	88.8950	89.5063	89.7356	(217)
Fuel for water heating, kWh/month													
	182.6898	160.4059	167.0085	148.0025	144.5428	127.3789	119.7166	134.9873	135.8928	153.4994	164.4615	177.3466	(219)
Water heating fuel used												1815.9326	(219)
Annual totals kWh/year													
Space heating fuel - main system												2573.6472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3583.6737	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2573.6472	3.4800	89.5629	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1815.9326	3.4800	63.1945	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	337.6510	13.1900	44.5362	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			166.4584	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5713	(257)
SAP value		92.0301	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2573.6472	0.2160	555.9078	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1815.9326	0.2160	392.2414	(264)
Space and water heating			948.1492	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			529.8840	(272)
CO2 emissions per m2			6.8500	(273)
EI value			94.1976	
EI rating			94	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8857 = 3.929, stars = 4
Water heating environmental impact	0.216 / 0.8857 = 0.2439, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3094	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3249	0.3016	0.3094	0.2939	0.2939	0.2862	0.2784	0.2707	0.2630	0.2862	0.2707	0.2862	(22b)
Effective ac	0.5528	0.5455	0.5479	0.5432	0.5432	0.5409	0.5388	0.5366	0.5346	0.5409	0.5366	0.5409	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.0250	32.5907	32.7319	32.4531	32.4531	32.3191	32.1886	32.0618	31.9384	32.3191	32.0618	32.3191	(38)
Heat transfer coeff	91.0072	90.5729	90.7141	90.4353	90.4353	90.3013	90.1708	90.0439	89.9206	90.3013	90.0439	90.3013	(39)
Average = Sum(39)m / 12 =												90.3540	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1763	1.1706	1.1725	1.1689	1.1689	1.1671	1.1654	1.1638	1.1622	1.1671	1.1638	1.1671	(40)
HLP (average)												1.1678	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Total heat required for water heating calculated for each month

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)
								Total per year (kWh/year) = Sum(64)m =				1610.4406 (64)

Heat gains from water heating, kWh/month

	53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	47.7980	42.4538	34.5257	26.1382	19.5386	16.4953	17.8238	23.1680	31.0960	39.4836	46.0832	49.1265 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	319.1884	322.5005	314.1540	296.3851	273.9551	252.8740	238.7906	235.4784	243.8250	261.5939	284.0239	305.1049 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426 (71)

Water heating gains (Table 5)

	71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978 (72)

Total internal gains

	541.6916	537.5376	516.8610	484.7229	451.8089	422.2177	404.8195	412.8046	431.1971	463.5440	499.5643	526.8279 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	13.4839	0.4600	0.0000	0.7700	4.9670	(74)
Northeast	0.8200	14.6176	0.4600	0.0000	0.7700	4.2456	(75)
Southeast	2.6100	45.1778	0.4600	0.0000	0.7700	41.7652	(77)
Southwest	3.4000	45.1778	0.4600	0.0000	0.7700	54.4068	(79)
West	1.0400	25.1925	0.4600	0.0000	0.7700	9.2801	(80)
Northwest	2.8100	14.6176	0.4600	0.0000	0.7700	14.5490	(81)
Northwest	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(81)

Solar gains	152.5645	236.5001	366.4578	523.0177	612.5522	686.6100	646.0806	563.2491	442.6764	293.7129	185.4295	126.2403 (83)
Total gains	694.2561	774.0377	883.3188	1007.7406	1064.3612	1108.8277	1050.9001	976.0537	873.8735	757.2569	684.9938	653.0682 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.0599	61.3526	61.2571	61.4460	61.4460	61.5372	61.6262	61.7130	61.7977	61.5372	61.7130	61.5372	
alpha	5.0707	5.0902	5.0838	5.0964	5.0964	5.1025	5.1084	5.1142	5.1198	5.1025	5.1142	5.1025	
util living area	0.9879	0.9789	0.9460	0.8489	0.6779	0.4592	0.3338	0.3585	0.6216	0.8871	0.9730	0.9904	(86)
MIT	20.0832	20.2177	20.4887	20.7826	20.9445	20.9935	20.9990	20.9986	20.9725	20.7701	20.3951	20.0597	(87)
Th 2	19.9390	19.9436	19.9421	19.9450	19.9450	19.9464	19.9477	19.9491	19.9503	19.9464	19.9491	19.9464	(88)
util rest of house	0.9840	0.9721	0.9292	0.8078	0.6086	0.3767	0.2442	0.2626	0.5294	0.8440	0.9627	0.9871	(89)
MIT 2	18.7579	18.9538	19.3330	19.7197	19.9009	19.9432	19.9475	19.9487	19.9339	19.7174	19.2143	18.7297	(90)
Living area fraction										fLA = Living area / (4) =		0.2130	(91)
MIT	19.0402	19.2230	19.5791	19.9461	20.1232	20.1669	20.1715	20.1723	20.1552	19.9417	19.4658	19.0130	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8902	19.0730	19.4291	19.7961	19.9732	20.0169	20.0215	20.0223	20.0052	19.7917	19.3158	18.8630	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9646	0.9190	0.8012	0.6105	0.3823	0.2505	0.2694	0.5344	0.8364	0.9543	0.9824	(94)
Useful gains	679.2994	746.6608	811.8045	807.4362	649.8352	423.9486	263.2620	262.9027	467.0300	633.3841	653.7080	641.5596	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1273.2056	1247.4625	1127.4975	931.1326	675.8410	425.9437	263.4302	263.1384	477.0433	757.7769	1027.9225	1251.8456	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	441.8662	336.5387	234.8756	89.0614	19.3483	0.0000	0.0000	0.0000	0.0000	92.5483	269.4345	454.0528	(98)
Space heating												1937.7258	(98)
Space heating per m2											(98) / (4) =	25.0449	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2141.1335	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	441.8662	336.5387	234.8756	89.0614	19.3483	0.0000	0.0000	0.0000	0.0000	92.5483	269.4345	454.0528	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	488.2500	371.8660	259.5310	98.4104	21.3794	0.0000	0.0000	0.0000	0.0000	102.2633	297.7176	501.7158	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6114	89.5181	89.2292	88.5647	87.7096	87.3000	87.3000	87.3000	87.3000	88.5656	89.3429	89.6472	(217)
Fuel for water heating, kWh/month													
	182.8616	160.5398	167.2652	148.4452	144.9690	127.3789	119.7166	134.9873	135.8928	154.0703	164.7623	177.5214	(219)
Water heating fuel used												1818.4105	(219)
Annual totals kWh/year													
Space heating fuel - main system												2141.1335	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =											-1368.9771	-1368.9771	(233)
Total delivered energy for all uses												3003.2178	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2141.1335	10.2300	219.0380	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1818.4105	10.2300	186.0234	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	337.6510	36.7200	123.9855	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			156.8984	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2141.1335	0.2160	462.4848	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1818.4105	0.2160	392.7767	(264)
Space and water heating			855.2615	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			358.9282	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2141.1335	1.2200	2612.1828	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1818.4105	1.2200	2218.4608	(264)
Space and water heating			4830.6436	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	337.6510	3.0700	1036.5886	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/year 1894.7225 (272)
Primary energy kWh/m2/year 24.4891 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£152	£152	£0
Mains gas	£508	£508	£0
Space heating	£350	£350	£0
Water heating	£186	£186	£0
Lighting	£124	£124	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£157	£157	£0
Total cost of uses	£157	£157	£0
Delivered energy	39 kWh/m²	39 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.4 tonnes	0.0 tonnes
CO2 emissions per m²	5 kg/m²	5 kg/m²	0 kg/m²
Primary energy	24 kWh/m²	24 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	258.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	3.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	179.24 (P1)
Transmission heat loss coefficient	57.98 (37)
Summer heat loss coefficient	237.22 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.0400	87.1704	0.4600	0.0000	0.9000	37.5321
North East	0.8200	106.0502	0.4600	0.0000	0.9000	36.0019
South East	2.6100	127.3119	0.4600	0.0000	0.9000	137.5656
South West	3.4000	127.3119	0.4600	0.0000	0.9000	179.2042
West	1.0400	125.2818	0.4600	0.0000	0.9000	53.9413
North West	2.8100	106.0502	0.4600	0.0000	0.9000	123.3725
North West	4.5100	106.0502	0.4600	0.0000	0.9000	198.0106
total:						765.6281

	Jun	Jul	Aug	
Solar gains	827	766	665	(P4)
Internal gains	419	402	410	
Total summer gains	1246	1167	1075	(P5)
Summer gain/loss ratio	5.25	4.92	4.53	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 258.6)	0.19	0.19	0.19	
Threshold temperature	20.84	22.41	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-343	**Issued on Date**	03/05/2023
Assessment Reference	As Built	**Prop Type Ref**	2-As-SEMI
Property	13, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	92 A	**DER**	8.99	**TER**	18.61
Environmental	94 A	**% DER<TER**	51.69		
CO_2 Emissions (t/year)	0.43	**DFEE**	45.75	**TFEE**	53.68
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.78		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.61 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.63 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South West: 9.19 m², No overhang
Windows facing North West: 2.47 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6300	
Infiltration rate			0.3760	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4434	0.4347	0.4260	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087	(22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9948	40.7332	40.4768	39.2725	39.0472	37.9983	37.9983	37.8041	38.4023	39.0472	39.5030	39.9796	(38)
Heat transfer coeff	99.4630	99.2014	98.9450	97.7407	97.5154	96.4664	96.4664	96.2722	96.8705	97.5154	97.9712	98.4477	(39)
Average = Sum(39)m / 12 =												97.7396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2383	1.2351	1.2319	1.2169	1.2141	1.2010	1.2010	1.1986	1.2061	1.2141	1.2198	1.2257	(40)
HLP (average)												1.2169	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	519.7752	627.1702	728.5554	830.8917	900.8059	889.6994	848.4470	783.5275	709.1919	606.1500	519.4706	486.7343	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.9976	33.0846	33.1704	33.5791	33.6567	34.0226	34.0226	34.0913	33.8807	33.6567	33.5001	33.3379	
alpha	3.1998	3.2056	3.2114	3.2386	3.2438	3.2682	3.2682	3.2728	3.2587	3.2438	3.2333	3.2225	
util living area													
	0.9832	0.9690	0.9407	0.8778	0.7669	0.6125	0.4728	0.5236	0.7420	0.9146	0.9721	0.9862	(86)
MIT	19.0532	19.3237	19.7293	20.2283	20.6319	20.8761	20.9602	20.9442	20.7573	20.2167	19.5424	19.0061	(87)
Th 2	19.8895	19.8920	19.8946	19.9065	19.9087	19.9192	19.9192	19.9211	19.9152	19.9087	19.9042	19.8995	(88)
util rest of house													
	0.9797	0.9627	0.9283	0.8518	0.7174	0.5321	0.3675	0.4164	0.6709	0.8906	0.9653	0.9833	(89)
MIT 2	17.3075	17.6997	18.2827	18.9888	19.5239	19.8197	19.8982	19.8892	19.6962	18.9907	18.0280	17.2452	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7448	18.1065	18.6451	19.2993	19.8015	20.0843	20.1642	20.1535	19.9620	19.2978	18.4074	17.6863	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5948	17.9565	18.4951	19.1493	19.6515	19.9343	20.0142	20.0035	19.8120	19.1478	18.2574	17.5363	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9688	0.9470	0.9076	0.8300	0.7042	0.5333	0.3772	0.4251	0.6632	0.8690	0.9505	0.9739	(94)
Useful gains	503.5564	593.9597	661.2365	689.6013	634.3733	474.4596	320.0489	333.0509	470.3090	526.7734	493.7741	474.0282	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1322.3380	1295.2236	1186.8534	1001.7741	775.3900	514.5803	329.3585	346.9130	553.3273	833.5458	1093.1015	1312.9300	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	609.1735	471.2493	391.0590	224.7644	104.9164	0.0000	0.0000	0.0000	0.0000	228.2386	431.5157	624.1429	(98)
Space heating												3085.0600	(98)
Space heating per m2											(98) / (4) =	38.4096	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3408.9060	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	609.1735	471.2493	391.0590	224.7644	104.9164	0.0000	0.0000	0.0000	0.0000	228.2386	431.5157	624.1429	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	673.1199	520.7175	432.1094	248.3585	115.9298	0.0000	0.0000	0.0000	0.0000	252.1974	476.8130	689.6607	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7948	89.7234	89.5840	89.2820	88.7077	87.3000	87.3000	87.3000	87.3000	89.2654	89.6556	89.8238	(217)
Fuel for water heating, kWh/month													
	184.9912	162.3697	168.8730	149.2381	145.2549	129.0595	121.2740	136.7748	137.7020	154.9249	166.4298	179.5957	(219)
Water heating fuel used												1836.4876	(219)
Annual totals kWh/year													
Space heating fuel - main system												3408.9060	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4452.8827	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3408.9060	0.2160	736.3237	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4876	0.2160	396.6813	(264)
Space and water heating			1133.0050	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			721.6918	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		8.9900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		27.4483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.4483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9281	(36)
Total fabric heat loss	(33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	124.3727	218.8393	317.9834	425.1026	504.5423	513.3824	489.7582	428.5834	354.7787	246.8677	150.2421	105.6138	(83)
Total gains	512.1956	604.3065	689.3087	773.9966	830.6578	817.5247	780.0371	725.4638	663.4893	578.2217	507.5196	482.1419	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9974	0.9938	0.9836	0.9493	0.8578	0.6885	0.5225	0.5790	0.8263	0.9693	0.9944	0.9980	(86)
MIT	19.7004	19.8764	20.1507	20.5037	20.7925	20.9497	20.9895	20.9830	20.8742	20.4938	20.0328	19.6732	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9965	0.9916	0.9777	0.9306	0.8075	0.5948	0.4023	0.4554	0.7490	0.9543	0.9921	0.9974	(89)
MIT 2	18.1813	18.4398	18.8388	19.3471	19.7255	19.9042	19.9331	19.9322	19.8338	19.3441	18.6784	18.1494	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5619	18.7997	19.1674	19.6368	19.9928	20.1661	20.1977	20.1954	20.0944	19.6321	19.0177	18.5311	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5619	18.7997	19.1674	19.6368	19.9928	20.1661	20.1977	20.1954	20.0944	19.6321	19.0177	18.5311	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9886	0.9724	0.9244	0.8111	0.6163	0.4326	0.4865	0.7624	0.9489	0.9894	0.9961	(94)
Useful gains	509.5513	597.3965	670.2609	715.4782	673.7774	503.8218	337.4257	352.9150	505.8408	548.6742	502.1166	480.2521	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1397.5902	1358.0945	1234.1208	1031.7965	794.8698	527.0911	340.6903	358.6015	570.3183	865.7375	1148.3001	1388.3596	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	660.7010	511.1890	419.5118	227.7492	90.0927	0.0000	0.0000	0.0000	0.0000	235.8951	465.2522	675.6319	(98)
Space heating												3286.0229	(98)
Space heating per m2											(98) / (4) =	40.9116	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3518.2258	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	660.7010	511.1890	419.5118	227.7492	90.0927	0.0000	0.0000	0.0000	0.0000	235.8951	465.2522	675.6319	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	707.3886	547.3116	449.1561	243.8428	96.4590	0.0000	0.0000	0.0000	0.0000	252.5644	498.1287	723.3747	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8100	87.5586	87.0501	85.8777	83.6843	80.3000	80.3000	80.3000	80.3000	85.8471	87.2934	87.8980	(217)
Fuel for water heating, kWh/month													
	230.4978	203.0016	212.4439	190.9995	189.7681	174.1812	166.8789	186.0308	188.0853	200.3335	210.3091	224.8305	(219)
Water heating fuel used												2377.3604	(219)
Annual totals kWh/year													
Space heating fuel - main system												3518.2258	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6321.6324	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3518.2258	0.2160	759.9368	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.3604	0.2160	513.5099	(264)
Space and water heating			1273.4466	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1494.5646	(272)
Emissions per m2 for space and water heating			15.8547	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8547 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.6300	
Infiltration rate				0.3760	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4434	0.4347	0.4260	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087	(22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9948	40.7332	40.4768	39.2725	39.0472	37.9983	37.9983	37.8041	38.4023	39.0472	39.5030	39.9796	(38)
Heat transfer coeff	99.4630	99.2014	98.9450	97.7407	97.5154	96.4664	96.4664	96.2722	96.8705	97.5154	97.9712	98.4477	(39)
Average = Sum(39)m / 12 =												97.7396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2383	1.2351	1.2319	1.2169	1.2141	1.2010	1.2010	1.1986	1.2061	1.2141	1.2198	1.2257	(40)
HLP (average)												1.2169	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	487.4194	595.5955	698.6029	803.1417	874.4869	865.3924	825.8467	758.7366	683.6198	578.2989	489.0456	455.1540	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.9976	33.0846	33.1704	33.5791	33.6567	34.0226	34.0226	34.0913	33.8807	33.6567	33.5001	33.3379	
alpha	3.1998	3.2056	3.2114	3.2386	3.2438	3.2682	3.2682	3.2728	3.2587	3.2438	3.2333	3.2225	
util living area													
	0.9859	0.9730	0.9465	0.8863	0.7781	0.6246	0.4838	0.5373	0.7565	0.9235	0.9763	0.9886	(86)
MIT	19.0017	19.2759	19.6884	20.1984	20.6141	20.8686	20.9575	20.9398	20.7418	20.1820	19.4956	18.9551	(87)
Th 2	19.8895	19.8920	19.8946	19.9065	19.9087	19.9192	19.9192	19.9211	19.9152	19.9087	19.9042	19.8995	(88)
util rest of house													
	0.9830	0.9674	0.9351	0.8615	0.7295	0.5439	0.3768	0.4285	0.6866	0.9014	0.9704	0.9862	(89)
MIT 2	18.0756	18.3484	18.7550	19.2530	19.6319	19.8467	19.9038	19.8974	19.7547	19.2503	18.5775	18.0367	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3076	18.5808	18.9888	19.4898	19.8779	20.1027	20.1677	20.1585	20.0020	19.4837	18.8075	18.2668	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3076	18.5808	18.9888	19.4898	19.8779	20.1027	20.1677	20.1585	20.0020	19.4837	18.8075	18.2668	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9772	0.9587	0.9234	0.8504	0.7280	0.5586	0.4025	0.4538	0.6929	0.8907	0.9625	0.9812	(94)
Useful gains	476.2840	570.9772	645.1228	683.0241	636.6251	483.3887	332.3944	344.3248	473.6490	515.1002	470.7274	446.6071	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1393.2384	1357.1506	1235.7053	1035.0581	797.4724	530.8226	344.1641	361.8405	571.7275	866.2945	1146.9989	1384.8421	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	682.2141	528.3086	439.3934	253.4645	119.6704	0.0000	0.0000	0.0000	0.0000	261.2886	486.9155	698.0468	(98)
Space heating												3469.3018	(98)
Space heating per m2											(98) / (4) =	43.1935	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	906.7846	713.8517	731.6687	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8347	0.8889	0.8631	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	756.8592	634.5553	631.4752	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1103.6518	1055.5287	978.6572	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	249.6907	313.2043	258.3035	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												821.1984	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	62.4227	78.3011	64.5759	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												205.2996	(107)
Space cooling per m2												2.5560	(108)
Energy for space heating												43.1935	(99)
Energy for space cooling												2.5560	(108)
Total												45.7495	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	124.3727	218.8393	317.9834	425.1026	504.5423	513.3824	489.7582	428.5834	354.7787	246.8677	150.2421	105.6138	(83)
Total gains	467.6463	560.8040	648.0492	735.5580	794.2736	783.7738	747.9839	690.5996	627.2163	539.0513	465.1598	438.3633	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9982	0.9955	0.9872	0.9576	0.8740	0.7101	0.5428	0.6040	0.8491	0.9765	0.9962	0.9987	(86)
MIT	19.6495	19.8276	20.1065	20.4685	20.7712	20.9424	20.9876	20.9796	20.8560	20.4542	19.9850	19.6230	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9976	0.9939	0.9825	0.9414	0.8268	0.6163	0.4189	0.4771	0.7762	0.9645	0.9946	0.9983	(89)
MIT 2	18.6772	18.8568	19.1354	19.4975	19.7725	19.9109	19.9338	19.9333	19.8533	19.4915	19.0250	18.6595	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9208	19.1000	19.3787	19.7407	20.0227	20.1693	20.1978	20.1954	20.1045	19.7327	19.2655	18.9008	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9208	19.1000	19.3787	19.7407	20.0227	20.1693	20.1978	20.1954	20.1045	19.7327	19.2655	18.9008	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9923	0.9795	0.9380	0.8317	0.6383	0.4503	0.5092	0.7897	0.9617	0.9932	0.9977	(94)
Useful gains	466.1754	556.4831	634.7657	689.9420	660.6124	500.3043	336.8056	351.6703	495.3358	518.4162	462.0011	437.3481	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1432.7620	1387.4383	1254.7024	1041.7820	797.7402	527.3910	340.6949	358.6001	571.2727	875.3769	1172.1750	1424.1766	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	719.1404	558.4018	461.2329	253.3248	102.0231	0.0000	0.0000	0.0000	0.0000	265.5788	511.3253	734.2004	(98)
Space heating												3605.2276	(98)
Space heating per m2											(98) / (4) =	44.8858	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8786	0.9333	0.9099	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	782.0495	654.0048	653.3519	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1008.2534	964.5203	899.0165	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	162.8668	231.0235	182.7744	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												576.6648	(104)

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Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	40.7167	57.7559	45.6936	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												144.1662 (107)
Space cooling per m2												1.7949 (108)
Energy for space heating												44.8858 (99)
Energy for space cooling												1.7949 (108)
Total												46.6807 (109)
Target Fabric Energy Efficiency (TFEE)												53.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3760	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3652	0.3391	0.3478	0.3304	0.3304	0.3217	0.3130	0.3043	0.2956	0.3217	0.3043	0.3217	(22b)
Effective ac	0.5667	0.5575	0.5605	0.5546	0.5546	0.5517	0.5490	0.5463	0.5437	0.5517	0.5463	0.5517	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7399	(36)
Total fabric heat loss	(33) + (36) = 58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8271	38.1977	38.4023	37.9983	37.9983	37.8041	37.6150	37.4311	37.2524	37.8041	37.4311	37.8041	(38)
Heat transfer coeff	97.2952	96.6659	96.8705	96.4664	96.4664	96.2722	96.0831	95.8993	95.7206	96.2722	95.8993	96.2722	(39)
Average = Sum(39)m / 12 =												96.3486	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2113	1.2035	1.2061	1.2010	1.2010	1.1986	1.1963	1.1940	1.1917	1.1986	1.1940	1.1986	(40)
HLP (average)												1.1996	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	178.6414	268.2066	395.0153	535.0506	606.3408	671.2416	634.9285	567.4298	466.7916	327.0180	215.2306	149.0433	(83)
Total gains	734.1258	819.3920	924.8993	1031.8542	1069.2543	1103.7446	1049.6045	990.2956	908.6403	802.1591	727.4149	689.2733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7328	33.9524	33.8807	34.0226	34.0226	34.0913	34.1584	34.2239	34.2878	34.0913	34.2239	34.0913	
alpha	3.2489	3.2635	3.2587	3.2682	3.2682	3.2728	3.2772	3.2816	3.2859	3.2728	3.2816	3.2728	
util living area	0.9528	0.9337	0.8864	0.7926	0.6561	0.4704	0.3491	0.3679	0.5935	0.8170	0.9225	0.9589	(86)
MIT	19.5218	19.7141	20.0842	20.5017	20.7975	20.9495	20.9857	20.9834	20.8908	20.5401	19.9975	19.4956	(87)
Th 2	19.9109	19.9172	19.9152	19.9192	19.9192	19.9211	19.9230	19.9248	19.9266	19.9211	19.9248	19.9211	(88)
util rest of house	0.9437	0.9213	0.8654	0.7556	0.5966	0.3905	0.2561	0.2707	0.5128	0.7745	0.9055	0.9508	(89)
MIT 2	17.9939	18.2705	18.7881	19.3546	19.7245	19.8864	19.9170	19.9178	19.8405	19.4222	18.6842	17.9639	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3767	18.6321	19.1128	19.6419	19.9933	20.1527	20.1847	20.1847	20.1036	19.7023	19.0132	18.3476	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2267	18.4821	18.9628	19.4919	19.8433	20.0027	20.0347	20.0347	19.9536	19.5523	18.8632	18.1976	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9250	0.9003	0.8431	0.7390	0.5921	0.3968	0.2660	0.2809	0.5150	0.7575	0.8841	0.9333	(94)
Useful gains	679.0392	737.7346	779.8173	762.5217	633.1549	437.9585	279.1886	278.1784	467.9671	607.6593	643.0730	643.2906	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1296.6214	1274.2591	1158.8397	963.8842	708.3832	452.7391	281.9762	281.4380	502.8773	784.8362	1051.3590	1270.5613	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	459.4812	360.5445	281.9927	144.9810	55.9698	0.0000	0.0000	0.0000	0.0000	131.8197	293.9659	466.6894	(98)

Space heating 2195.4442 (98)
RHI space heating demand 2195 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6300	
Infiltration rate			0.3760	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4434	0.4347	0.4260	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087	(22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9948	40.7332	40.4768	39.2725	39.0472	37.9983	37.9983	37.8041	38.4023	39.0472	39.5030	39.9796	(38)
Heat transfer coeff	99.4630	99.2014	98.9450	97.7407	97.5154	96.4664	96.4664	96.2722	96.8705	97.5154	97.9712	98.4477	(39)
Average = Sum(39)m / 12 =												97.7396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2383	1.2351	1.2319	1.2169	1.2141	1.2010	1.2010	1.1986	1.2061	1.2141	1.2198	1.2257	(40)
HLP (average)												1.2169	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	699.6300	804.8162	898.4210	989.4900	1047.6691	1027.5040	982.2970	919.5862	853.0310	761.2564	686.3122	662.6344	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.9976	33.0846	33.1704	33.5791	33.6567	34.0226	34.0226	34.0913	33.8807	33.6567	33.5001	33.3379	
alpha	3.1998	3.2056	3.2114	3.2386	3.2438	3.2682	3.2682	3.2728	3.2587	3.2438	3.2333	3.2225	
util living area													
	0.9626	0.9416	0.9034	0.8272	0.7066	0.5497	0.4158	0.4577	0.6650	0.8603	0.9427	0.9679	(86)
MIT	19.3282	19.5779	19.9434	20.3800	20.7161	20.9100	20.9727	20.9624	20.8273	20.3879	19.7840	19.2801	(87)
Th 2	19.8895	19.8920	19.8946	19.9065	19.9087	19.9192	19.9192	19.9211	19.9152	19.9087	19.9042	19.8995	(88)
util rest of house													
	0.9554	0.9307	0.8853	0.7950	0.6535	0.4721	0.3203	0.3596	0.5904	0.8267	0.9301	0.9616	(89)
MIT 2	17.7023	18.0601	18.5783	19.1854	19.6196	19.8491	19.9052	19.9004	19.7659	19.2140	18.3692	17.6398	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1096	18.4403	18.9202	19.4847	19.8943	20.1148	20.1726	20.1664	20.0318	19.5081	18.7236	18.0507	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9596	18.2903	18.7702	19.3347	19.7443	19.9648	20.0226	20.0164	19.8818	19.3581	18.5736	17.9007	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9382	0.9100	0.8624	0.7755	0.6447	0.4756	0.3297	0.3687	0.5879	0.8063	0.9098	0.9458	(94)
Useful gains	656.3822	732.3684	774.8231	767.3508	675.4068	488.6750	323.8939	339.0060	501.4896	613.7873	624.4303	626.7258	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1358.6223	1328.3396	1214.0784	1019.8919	784.4390	517.5267	330.1668	348.1588	560.0849	854.0461	1124.0812	1348.7994	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	522.4666	400.4926	326.8059	181.8296	81.1200	0.0000	0.0000	0.0000	0.0000	178.7526	359.7487	537.2228	(98)
Space heating												2588.4387	(98)
Space heating per m2											(98) / (4) =	32.2266	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2860.1533	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	522.4666	400.4926	326.8059	181.8296	81.1200	0.0000	0.0000	0.0000	0.0000	178.7526	359.7487	537.2228	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	577.3112	442.5333	361.1115	200.9167	89.6353	0.0000	0.0000	0.0000	0.0000	197.5167	397.5124	593.6163	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7068	89.6237	89.4623	89.1185	88.5091	87.3000	87.3000	87.3000	87.3000	89.0758	89.5378	89.7403	(217)
Fuel for water heating, kWh/month													
	185.1727	162.5502	169.1027	149.5118	145.5809	129.0595	121.2740	136.7748	137.7020	155.2548	166.6487	179.7627	(219)
Water heating fuel used												1838.3949	(219)
Annual totals kWh/year													
Space heating fuel - main system												2860.1533	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3906.0372	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2860.1533	3.4800	99.5333	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3949	3.4800	63.9761	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			178.9773	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5998	(257)
SAP value		91.6324	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2860.1533	0.2160	617.7931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3949	0.2160	397.0933	(264)
Space and water heating			1014.8864	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			603.5732	(272)
CO2 emissions per m2			7.5100	(273)
EI value			93.5462	
EI rating			94	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8866 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6300	
Infiltration rate			0.3760	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3652	0.3391	0.3478	0.3304	0.3304	0.3217	0.3130	0.3043	0.2956	0.3217	0.3043	0.3217	(22b)
Effective ac	0.5667	0.5575	0.5605	0.5546	0.5546	0.5517	0.5490	0.5463	0.5437	0.5517	0.5463	0.5517	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8271	38.1977	38.4023	37.9983	37.9983	37.8041	37.6150	37.4311	37.2524	37.8041	37.4311	37.8041	(38)
Heat transfer coeff	97.2952	96.6659	96.8705	96.4664	96.4664	96.2722	96.0831	95.8993	95.7206	96.2722	95.8993	96.2722	(39)
Average = Sum(39)m / 12 =												96.3486	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2113	1.2035	1.2061	1.2010	1.2010	1.1986	1.1963	1.1940	1.1917	1.1986	1.1940	1.1986	(40)
HLP (average)												1.1996	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	178.6414	268.2066	395.0153	535.0506	606.3408	671.2416	634.9285	567.4298	466.7916	327.0180	215.2306	149.0433	(83)
Total gains	734.1258	819.3920	924.8993	1031.8542	1069.2543	1103.7446	1049.6045	990.2956	908.6403	802.1591	727.4149	689.2733	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7328	33.9524	33.8807	34.0226	34.0226	34.0913	34.1584	34.2239	34.2878	34.0913	34.2239	34.0913	
alpha	3.2489	3.2635	3.2587	3.2682	3.2682	3.2728	3.2772	3.2816	3.2859	3.2728	3.2816	3.2728	
util living area													
	0.9528	0.9337	0.8864	0.7926	0.6561	0.4704	0.3491	0.3679	0.5935	0.8170	0.9225	0.9589	(86)
MIT	19.5218	19.7141	20.0842	20.5017	20.7975	20.9495	20.9857	20.9834	20.8908	20.5401	19.9975	19.4956	(87)
Th 2	19.9109	19.9172	19.9152	19.9192	19.9192	19.9211	19.9230	19.9248	19.9266	19.9211	19.9248	19.9211	(88)
util rest of house													
	0.9437	0.9213	0.8654	0.7556	0.5966	0.3905	0.2561	0.2707	0.5128	0.7745	0.9055	0.9508	(89)
MIT 2	17.9939	18.2705	18.7881	19.3546	19.7245	19.8864	19.9170	19.9178	19.8405	19.4222	18.6842	17.9639	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3767	18.6321	19.1128	19.6419	19.9933	20.1527	20.1847	20.1847	20.1036	19.7023	19.0132	18.3476	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2267	18.4821	18.9628	19.4919	19.8433	20.0027	20.0347	20.0347	19.9536	19.5523	18.8632	18.1976	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9250	0.9003	0.8431	0.7390	0.5921	0.3968	0.2660	0.2809	0.5150	0.7575	0.8841	0.9333	(94)
Useful gains	679.0392	737.7346	779.8173	762.5217	633.1549	437.9585	279.1886	278.1784	467.9671	607.6593	643.0730	643.2906	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1296.6214	1274.2591	1158.8397	963.8842	708.3832	452.7391	281.9762	281.4380	502.8773	784.8362	1051.3590	1270.5613	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	459.4812	360.5445	281.9927	144.9810	55.9698	0.0000	0.0000	0.0000	0.0000	131.8197	293.9659	466.6894	(98)
Space heating												2195.4442	(98)
Space heating per m2											(98) / (4) =	27.3337	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2425.9052	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	459.4812	360.5445	281.9927	144.9810	55.9698	0.0000	0.0000	0.0000	0.0000	131.8197	293.9659	466.6894	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	507.7140	398.3917	311.5941	160.2000	61.8451	0.0000	0.0000	0.0000	0.0000	145.6571	324.8242	515.6789	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6277	89.5553	89.3564	88.9387	88.2449	87.3000	87.3000	87.3000	87.3000	88.8329	89.3967	89.6558	(217)
Fuel for water heating, kWh/month													
	185.3361	162.6744	169.3032	149.8141	146.0167	129.0595	121.2740	136.7748	137.7020	155.6793	166.9117	179.9321	(219)
Water heating fuel used												1840.4781	(219)
Annual totals kWh/year													
Space heating fuel - main system												2425.9052	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3323.4523	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2425.9052	9.7400	236.2832	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.4781	9.7400	179.2626	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			172.0757	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2425.9052	0.2160	523.9955	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4781	0.2160	397.5433	(264)
Space and water heating			921.5388	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			432.1576	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2425.9052	1.2200	2959.6043	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4781	1.2200	2245.3833	(264)
Space and water heating			5204.9876	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2310.1894	(272)
Primary energy kWh/m2/year			28.7623	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (42.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 93	A 95
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£157	£175	-£18
Mains gas	£520	£424	£95
Space heating	£368	£368	£0
Water heating	£179	£102	£77
Lighting	£129	£129	£0
Generated (PV)	-£504	-£504	£0
Total cost of fuels	£173	£95	£77
Total cost of uses	£172	£95	£77
Delivered energy	41 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3760	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4434	0.4347	0.4260	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087	(22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9948	40.7332	40.4768	39.2725	39.0472	37.9983	37.9983	37.8041	38.4023	39.0472	39.5030	39.9796	(38)
Heat transfer coeff	99.4630	99.2014	98.9450	97.7407	97.5154	96.4664	96.4664	96.2722	96.8705	97.5154	97.9712	98.4477	(39)
Average = Sum(39)m / 12 =												97.7396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2383	1.2351	1.2319	1.2169	1.2141	1.2010	1.2010	1.1986	1.2061	1.2141	1.2198	1.2257	(40)
HLP (average)												1.2169	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)

Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045 (83)
Total gains	699.6300	804.8162	898.4210	989.4900	1047.6691	1027.5040	982.2970	919.5862	853.0310	761.2564	686.3122	662.6344 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.9976	33.0846	33.1704	33.5791	33.6567	34.0226	34.0226	34.0913	33.8807	33.6567	33.5001	33.3379	
alpha	3.1998	3.2056	3.2114	3.2386	3.2438	3.2682	3.2682	3.2728	3.2587	3.2438	3.2333	3.2225	
util living area	0.9626	0.9416	0.9034	0.8272	0.7066	0.5497	0.4158	0.4577	0.6650	0.8603	0.9427	0.9679	(86)
MIT	19.3282	19.5779	19.9434	20.3800	20.7161	20.9100	20.9727	20.9624	20.8273	20.3879	19.7840	19.2801	(87)
Th 2	19.8895	19.8920	19.8946	19.9065	19.9087	19.9192	19.9192	19.9211	19.9152	19.9087	19.9042	19.8995	(88)
util rest of house	0.9554	0.9307	0.8853	0.7950	0.6535	0.4721	0.3203	0.3596	0.5904	0.8267	0.9301	0.9616	(89)
MIT 2	17.7023	18.0601	18.5783	19.1854	19.6196	19.8491	19.9052	19.9004	19.7659	19.2140	18.3692	17.6398	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1096	18.4403	18.9202	19.4847	19.8943	20.1148	20.1726	20.1664	20.0318	19.5081	18.7236	18.0507	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9596	18.2903	18.7702	19.3347	19.7443	19.9648	20.0226	20.0164	19.8818	19.3581	18.5736	17.9007	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9382	0.9100	0.8624	0.7755	0.6447	0.4756	0.3297	0.3687	0.5879	0.8063	0.9098	0.9458	(94)
Useful gains	656.3822	732.3684	774.8231	767.3508	675.4068	488.6750	323.8939	339.0060	501.4896	613.7873	624.4303	626.7258	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1358.6223	1328.3396	1214.0784	1019.8919	784.4390	517.5267	330.1668	348.1588	560.0849	854.0461	1124.0812	1348.7994	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	522.4666	400.4926	326.8059	181.8296	81.1200	0.0000	0.0000	0.0000	0.0000	178.7526	359.7487	537.2228	(98)
Space heating												2588.4387	(98)
Space heating per m2											(98) / (4) =	32.2266	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2860.1533	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	522.4666	400.4926	326.8059	181.8296	81.1200	0.0000	0.0000	0.0000	0.0000	178.7526	359.7487	537.2228	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	577.3112	442.5333	361.1115	200.9167	89.6353	0.0000	0.0000	0.0000	0.0000	197.5167	397.5124	593.6163	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7980	89.8170	89.8414	89.9060	90.0251	87.3000	87.3000	87.3000	87.3000	89.4346	89.6769	89.8162	(217)
Fuel for water heating, kWh/month													
	157.7176	116.7093	90.9338	44.4714	15.1481	0.0000	0.0000	24.9065	50.0868	96.2290	134.0041	156.7977	(219)
Water heating fuel used												887.0043	(219)
Annual totals kWh/year													
Space heating fuel - main system												2860.1533	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3004.6466	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2860.1533	3.4800	99.5333	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	887.0043	3.4800	30.8677	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			152.4639	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5110	(257)
SAP value	92.8720	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2860.1533	0.2160	617.7931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	887.0043	0.2160	191.5929	(264)
Space and water heating			809.3860	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			424.0229	(272)
CO2 emissions per m2			5.2800	(273)
EI value			95.4661	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.6300	
Infiltration rate		0.3760	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3478	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3652	0.3391	0.3478	0.3304	0.3304	0.3217	0.3130	0.3043	0.2956	0.3217	0.3043	0.3217	(22b)
Effective ac	0.5667	0.5575	0.5605	0.5546	0.5546	0.5517	0.5490	0.5463	0.5437	0.5517	0.5463	0.5517	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8271	38.1977	38.4023	37.9983	37.9983	37.8041	37.6150	37.4311	37.2524	37.8041	37.4311	37.8041	(38)
Heat transfer coeff	97.2952	96.6659	96.8705	96.4664	96.4664	96.2722	96.0831	95.8993	95.7206	96.2722	95.8993	96.2722	(39)
Average = Sum(39)m / 12 =												96.3486	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2113	1.2035	1.2061	1.2010	1.2010	1.1986	1.1963	1.1940	1.1917	1.1986	1.1940	1.1986	(40)
HLP (average)												1.1996	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3896	(H8)
Utilisation factor												0.5131	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-876.6189	(H17)
Solar input -28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154	(63)	
										Solar input (sum of months) = Sum(63)m =	-876.6189	(63)	
Output from w/h													
137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)	
										Total per year (kWh/year) = Sum(64)m =	771.1322	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	178.6414	268.2066	395.0153	535.0506	606.3408	671.2416	634.9285	567.4298	466.7916	327.0180	215.2306	149.0433	(83)
Total gains	734.1258	819.3920	924.8993	1031.8542	1069.2543	1103.7446	1049.6045	990.2956	908.6403	802.1591	727.4149	689.2733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7328	33.9524	33.8807	34.0226	34.0226	34.0913	34.1584	34.2239	34.2878	34.0913	34.2239	34.0913	
alpha	3.2489	3.2635	3.2587	3.2682	3.2682	3.2728	3.2772	3.2816	3.2859	3.2728	3.2816	3.2728	
util living area													
	0.9528	0.9337	0.8864	0.7926	0.6561	0.4704	0.3491	0.3679	0.5935	0.8170	0.9225	0.9589	(86)
MIT	19.5218	19.7141	20.0842	20.5017	20.7975	20.9495	20.9857	20.9834	20.8908	20.5401	19.9975	19.4956	(87)
Th 2	19.9109	19.9172	19.9152	19.9192	19.9192	19.9211	19.9230	19.9248	19.9266	19.9211	19.9248	19.9211	(88)
util rest of house													
	0.9437	0.9213	0.8654	0.7556	0.5966	0.3905	0.2561	0.2707	0.5128	0.7745	0.9055	0.9508	(89)
MIT 2	17.9939	18.2705	18.7881	19.3546	19.7245	19.8864	19.9170	19.9178	19.8405	19.4222	18.6842	17.9639	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3767	18.6321	19.1128	19.6419	19.9933	20.1527	20.1847	20.1847	20.1036	19.7023	19.0132	18.3476	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2267	18.4821	18.9628	19.4919	19.8433	20.0027	20.0347	20.0347	19.9536	19.5523	18.8632	18.1976	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9250	0.9003	0.8431	0.7390	0.5921	0.3968	0.2660	0.2809	0.5150	0.7575	0.8841	0.9333	(94)
Useful gains	679.0392	737.7346	779.8173	762.5217	633.1549	437.9585	279.1886	278.1784	467.9671	607.6593	643.0730	643.2906	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1296.6214	1274.2591	1158.8397	963.8842	708.3832	452.7391	281.9762	281.4380	502.8773	784.8362	1051.3590	1270.5613	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	459.4812	360.5445	281.9927	144.9810	55.9698	0.0000	0.0000	0.0000	0.0000	131.8197	293.9659	466.6894	(98)
Space heating												2195.4442	(98)
Space heating per m2											(98) / (4) =	27.3337	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2425.9052	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	459.4812	360.5445	281.9927	144.9810	55.9698	0.0000	0.0000	0.0000	0.0000	131.8197	293.9659	466.6894	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	507.7140	398.3917	311.5941	160.2000	61.8451	0.0000	0.0000	0.0000	0.0000	145.6571	324.8242	515.6789	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7423	89.7578	89.7630	89.8030	89.6968	87.3000	87.3000	87.3000	87.3000	89.2438	89.5745	89.7500	(217)
Fuel for water heating, kWh/month													
	153.2333	117.0035	90.6744	43.3653	20.1702	0.0000	0.0000	18.0306	44.7335	92.0872	128.8206	153.5422	(219)
Water heating fuel used												861.6610	(219)
Annual totals kWh/year													
Space heating fuel - main system												2425.9052	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2394.6352	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2425.9052	9.7400	236.2832	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.6610	9.7400	83.9258	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			95.1639	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2425.9052	0.2160	523.9955	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6610	0.2160	186.1188	(264)
Space and water heating			710.1143	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			246.6831 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2425.9052	1.2200	2959.6043	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6610	1.2200	1051.2264	(264)
Space and water heating			4010.8307	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1269.5325	(272)
Primary energy kWh/m2/year			15.8059	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07 (P1)
Transmission heat loss coefficient	58.47 (37)
Summer heat loss coefficient	332.54 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	106.0502	0.4600	0.0000	0.9000	159.3744
South West	4.6800	127.3119	0.4600	0.0000	0.9000	246.6693
North West	2.4700	106.0502	0.4600	0.0000	0.9000	108.4448
South West	4.5100	127.3119	0.4600	0.0000	0.9000	237.7091
total:						752.1975

	Jun	Jul	Aug	
Solar gains	808	752	670	(P4)
Internal gains	430	412	420	
Total summer gains	1238	1164	1090	(P5)
Summer gain/loss ratio	3.72	3.50	3.28	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.09	21.77	21.55	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-344	**Issued on Date**	03/05/2023
Assessment Reference	As Built	**Prop Type Ref**	2-Opp-SEMI
Property	12, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	92 A	**DER**	8.79	**TER**	18.35
Environmental	94 A	**% DER<TER**	52.09		
CO_2 Emissions (t/year)	0.42	**DFEE**	44.69	**TFEE**	52.14
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.29		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.35 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.79 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.73 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South East: 1.64 m², No overhang
Windows facing South West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.7300	
Infiltration rate				0.3810	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4493	0.4405	0.4317	0.3877	0.3788	0.3348	0.3348	0.3260	0.3524	0.3788	0.3965	0.4141	(22b)
Effective ac	0.6009	0.5970	0.5932	0.5751	0.5718	0.5560	0.5560	0.5531	0.5621	0.5718	0.5786	0.5857	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771	(36)
Total fabric heat loss	(33) + (36) =	57.4872	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1752	40.9066	40.6433	39.4068	39.1754	38.0984	38.0984	37.8990	38.5133	39.1754	39.6435	40.1328	(38)
Heat transfer coeff	98.6624	98.3938	98.1305	96.8940	96.6626	95.5856	95.5856	95.3862	96.0005	96.6626	97.1306	97.6199	(39)
Average = Sum(39)m / 12 =												96.8928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2284	1.2250	1.2217	1.2063	1.2035	1.1901	1.1901	1.1876	1.1952	1.2035	1.2093	1.2154	(40)
HLP (average)												1.2063	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
								Total per year (kWh/year) = Sum(64)m =				1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.7932	373.6847	360.1366	338.2948	316.1173	294.7548	280.8870	286.8864	298.1161	320.1699	345.5005	364.4981	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	531.4408	643.6288	742.2850	833.2487	890.0885	873.1887	834.9745	780.7066	719.1231	621.9666	532.8080	497.1322	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3876	33.4788	33.5686	33.9970	34.0783	34.4623	34.4623	34.5344	34.3134	34.0783	33.9141	33.7441	
alpha	3.2258	3.2319	3.2379	3.2665	3.2719	3.2975	3.2975	3.3023	3.2876	3.2719	3.2609	3.2496	
util living area													
	0.9822	0.9670	0.9379	0.8764	0.7697	0.6178	0.4762	0.5220	0.7343	0.9091	0.9702	0.9855	(86)
MIT	19.0941	19.3702	19.7675	20.2470	20.6355	20.8763	20.9607	20.9465	20.7706	20.2503	19.5822	19.0461	(87)
Th 2	19.8974	19.9000	19.9026	19.9149	19.9172	19.9280	19.9280	19.9300	19.9238	19.9172	19.9126	19.9077	(88)
util rest of house													
	0.9786	0.9602	0.9250	0.8502	0.7206	0.5377	0.3710	0.4156	0.6629	0.8840	0.9630	0.9825	(89)
MIT 2	17.3709	17.7708	18.3411	19.0199	19.5355	19.8283	19.9072	19.8993	19.7177	19.0415	18.0897	17.3075	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.8025	18.1714	18.6984	19.3273	19.8111	20.0908	20.1711	20.1616	19.9815	19.3443	18.4636	17.7430	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6525	18.0214	18.5484	19.1773	19.6611	19.9408	20.0211	20.0116	19.8315	19.1943	18.3136	17.5930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9674	0.9442	0.9042	0.8287	0.7075	0.5387	0.3806	0.4242	0.6560	0.8626	0.9479	0.9728	(94)
Useful gains	514.1113	607.7135	671.2015	690.5378	629.7004	470.3889	317.8003	331.1867	471.7127	536.5195	505.0519	483.6042	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1317.3940	1291.0675	1182.3188	995.8052	769.5387	510.5038	327.0059	344.4951	550.2231	830.7496	1089.1839	1307.4244	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	597.6423	459.2139	380.2713	219.7925	104.0397	0.0000	0.0000	0.0000	0.0000	218.9072	420.5750	612.9222	(98)
Space heating												3013.3641	(98)
Space heating per m2											(98) / (4) =	37.5170	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3329.6841	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	597.6423	459.2139	380.2713	219.7925	104.0397	0.0000	0.0000	0.0000	0.0000	218.9072	420.5750	612.9222	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	660.3782	507.4187	420.1893	242.8647	114.9610	0.0000	0.0000	0.0000	0.0000	241.8864	464.7238	677.2621	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7842	89.7081	89.5656	89.2651	88.7011	87.3000	87.3000	87.3000	87.3000	89.2336	89.6395	89.8141	(217)
Fuel for water heating, kWh/month													
	185.0130	162.3974	168.9077	149.2664	145.2658	129.0595	121.2740	136.7748	137.7020	154.9801	166.4596	179.6151	(219)
Water heating fuel used												1836.7154	(219)
Annual totals kWh/year													
Space heating fuel - main system												3329.6841	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4376.7785	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3329.6841	0.2160	719.2118	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.7154	0.2160	396.7305	(264)
Space and water heating			1115.9423	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			706.1290	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.7900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		8.7900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		27.2483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.2483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3945	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.4600	1.3258	19.1705			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.1800	13.6998			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.4419			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.7401 (36)
Total fabric heat loss	(33) + (36) =		55.1820 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.8560	96.5680	96.2858	94.9601	94.7120	93.5573	93.5573	93.3435	94.0021	94.7120	95.2138	95.7384	(39)
Average = Sum(39)m / 12 =												94.9589	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2059	1.2023	1.1988	1.1823	1.1792	1.1648	1.1648	1.1621	1.1703	1.1792	1.1854	1.1920	(40)
HLP (average)												1.1823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy			2.4689	(42)
Average daily hot water use (litres/day)			92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.9866	385.6125	371.4435	348.9834	326.1824	304.1988	290.3398	296.9598	308.8170	331.4892	357.4353	376.6963	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	1.6400	36.7938	0.6300	0.7000	0.7700	18.4413	(77)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)

Solar gains	134.2968	232.9148	329.7277	427.0591	495.2373	499.0878	478.0811	426.0809	363.2559	260.3981	161.6138	114.4402	(83)
Total gains	522.2834	618.5273	701.1712	776.0425	821.4197	803.2866	768.4210	723.0407	672.0729	591.8873	519.0491	491.1365	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.5884	57.7601	57.9294	58.7381	58.8920	59.6188	59.6188	59.7554	59.3367	58.8920	58.5816	58.2606	
alpha	4.8392	4.8507	4.8620	4.9159	4.9261	4.9746	4.9746	4.9837	4.9558	4.9261	4.9054	4.8840	
util living area													
	0.9971	0.9931	0.9822	0.9477	0.8589	0.6922	0.5243	0.5751	0.8170	0.9659	0.9938	0.9979	(86)
MIT	19.7306	19.9107	20.1801	20.5193	20.7961	20.9502	20.9898	20.9841	20.8840	20.5193	20.0617	19.7023	(87)
Th 2	19.9153	19.9182	19.9210	19.9342	19.9367	19.9483	19.9483	19.9504	19.9438	19.9367	19.9317	19.9264	(88)
util rest of house													
	0.9962	0.9907	0.9759	0.9286	0.8091	0.5992	0.4049	0.4532	0.7388	0.9496	0.9913	0.9972	(89)
MIT 2	18.2333	18.4975	18.8890	19.3772	19.7399	19.9157	19.9446	19.9441	19.8537	19.3877	18.7283	18.1999	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.6084	18.8515	19.2124	19.6633	20.0045	20.1749	20.2064	20.2046	20.1118	19.6712	19.0623	18.5762	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6084	18.8515	19.2124	19.6633	20.0045	20.1749	20.2064	20.2046	20.1118	19.6712	19.0623	18.5762	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9875	0.9704	0.9227	0.8127	0.6205	0.4350	0.4838	0.7528	0.9443	0.9884	0.9958	(94)
Useful gains	519.3792	610.7812	680.4276	716.0282	667.5863	498.4789	334.2280	349.8334	505.9492	558.8904	513.0098	489.0721	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1385.8505	1347.2665	1224.0226	1022.0843	786.5370	521.5700	337.4055	355.1345	565.1195	859.1486	1138.9767	1376.3564	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	644.6546	494.9181	404.4347	220.3604	88.4993	0.0000	0.0000	0.0000	0.0000	223.3922	450.6962	660.1395	(98)
Space heating												3187.0951	(98)
Space heating per m2											(98) / (4) =	39.6800	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3412.3074	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	644.6546	494.9181	404.4347	220.3604	88.4993	0.0000	0.0000	0.0000	0.0000	223.3922	450.6962	660.1395	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	690.2084	529.8909	433.0136	235.9319	94.7530	0.0000	0.0000	0.0000	0.0000	239.1779	482.5441	706.7875	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7624	87.4921	86.9677	85.7952	83.6442	80.3000	80.3000	80.3000	80.3000	85.7106	87.2246	87.8541	(217)
Fuel for water heating, kWh/month													
	230.6229	203.1560	212.6453	191.1832	189.8590	174.1812	166.8789	186.0308	188.0853	200.6526	210.4750	224.9429	(219)
Water heating fuel used												2378.7131	(219)
Annual totals kWh/year													
Space heating fuel - main system												3412.3074	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Total delivered energy for all uses												6219.9565	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3412.3074	0.2160	737.0584	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2378.7131	0.2160	513.8020	(264)
Space and water heating			1250.8604	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Total CO2, kg/m2/year			1473.4782	(272)
Emissions per m2 for space and water heating			15.5735	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2870	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.5735 * 1.00) + 2.2870 + 0.4846, rounded to 2 d.p.			18.3500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7300	
Infiltration rate			0.3810	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4493	0.4405	0.4317	0.3877	0.3788	0.3348	0.3348	0.3260	0.3524	0.3788	0.3965	0.4141	(22b)
Effective ac	0.6009	0.5970	0.5932	0.5751	0.5718	0.5560	0.5560	0.5531	0.5621	0.5718	0.5786	0.5857	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1752	40.9066	40.6433	39.4068	39.1754	38.0984	38.0984	37.8990	38.5133	39.1754	39.6435	40.1328	(38)
Heat transfer coeff	98.6624	98.3938	98.1305	96.8940	96.6626	95.5856	95.5856	95.3862	96.0005	96.6626	97.1306	97.6199	(39)
Average = Sum(39)m / 12 =												96.8928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2284	1.2250	1.2217	1.2063	1.2035	1.1901	1.1901	1.1876	1.1952	1.2035	1.2093	1.2154	(40)
HLP (average)												1.2063	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.4373	342.1100	330.1841	310.5448	289.7982	270.4479	258.2867	262.0955	272.5440	292.3188	315.0754	332.9178	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	499.0849	612.0541	712.3325	805.4987	863.7694	848.8817	812.3742	755.9157	693.5510	594.1155	502.3829	465.5519	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3876	33.4788	33.5686	33.9970	34.0783	34.4623	34.4623	34.5344	34.3134	34.0783	33.9141	33.7441	
alpha	3.2258	3.2319	3.2379	3.2665	3.2719	3.2975	3.2975	3.3023	3.2876	3.2719	3.2609	3.2496	
util living area													
	0.9851	0.9711	0.9439	0.8850	0.7810	0.6302	0.4874	0.5357	0.7489	0.9182	0.9746	0.9880	(86)
MIT	19.0428	19.3227	19.7270	20.2174	20.6176	20.8686	20.9579	20.9422	20.7557	20.2164	19.5358	18.9952	(87)
Th 2	19.8974	19.9000	19.9026	19.9149	19.9172	19.9280	19.9280	19.9300	19.9238	19.9172	19.9126	19.9077	(88)
util rest of house													
	0.9820	0.9651	0.9320	0.8600	0.7328	0.5498	0.3806	0.4278	0.6785	0.8950	0.9684	0.9854	(89)
MIT 2	18.1217	18.4000	18.7980	19.2771	19.6423	19.8552	19.9127	19.9071	19.7727	19.2885	18.6227	18.0820	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3524	18.6311	19.0307	19.5127	19.8866	20.1091	20.1745	20.1664	20.0189	19.5209	18.8514	18.3108	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3524	18.6311	19.0307	19.5127	19.8866	20.1091	20.1745	20.1664	20.0189	19.5209	18.8514	18.3108	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9561	0.9203	0.8492	0.7313	0.5644	0.4062	0.4530	0.6855	0.8846	0.9603	0.9803	(94)
Useful gains	487.0953	585.2097	655.5535	684.0500	631.7053	479.0800	330.0051	342.4135	475.4080	525.5411	482.4194	456.3848	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1386.4426	1351.0565	1229.6435	1028.3022	791.3418	526.5890	341.6700	359.2625	568.2185	862.3216	1141.4236	1377.4919	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	669.1144	514.6491	427.1229	247.8616	118.7695	0.0000	0.0000	0.0000	0.0000	250.5647	474.4830	685.3036	(98)
Space heating												3387.8689	(98)
Space heating per m2											(98) / (4) =	42.1796	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	898.5047	707.3335	724.9349	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8337	0.8891	0.8664	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	749.0473	628.8758	628.0586	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.4287	1039.8629	975.4656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	241.4746	305.7744	258.4708	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												805.7199	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.3687	76.4436	64.6177	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												201.4300	(107)
Space cooling per m2												2.5078	(108)
Energy for space heating												42.1796	(99)
Energy for space cooling												2.5078	(108)
Total												44.6875	(109)
Dwelling Fabric Energy Efficiency (DFEE)												44.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.4600	1.3258	19.1705			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.1800	13.6998			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.4419			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.7401	(36)
Total fabric heat loss (33) + (36) =	55.1820	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.8560	96.5680	96.2858	94.9601	94.7120	93.5573	93.5573	93.3435	94.0021	94.7120	95.2138	95.7384	(39)
Average = Sum(39)m / 12 =												94.9589	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2059	1.2023	1.1988	1.1823	1.1792	1.1648	1.1648	1.1621	1.1703	1.1792	1.1854	1.1920	(40)
HLP (average)												1.1823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.4373	342.1100	330.1841	310.5448	289.7982	270.4479	258.2867	262.0955	272.5440	292.3188	315.0754	332.9178	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	1.6400	36.7938	0.6300	0.7000	0.7700	18.4413	(77)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)

Solar gains	134.2968	232.9148	329.7277	427.0591	495.2373	499.0878	478.0811	426.0809	363.2559	260.3981	161.6138	114.4402	(83)
Total gains	477.7341	575.0248	659.9117	737.6039	785.0355	769.5357	736.3679	688.1765	635.7999	552.7169	476.6892	447.3579	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.5884	57.7601	57.9294	58.7381	58.8920	59.6188	59.6188	59.7554	59.3367	58.8920	58.5816	58.2606	
alpha	4.8392	4.8507	4.8620	4.9159	4.9261	4.9746	4.9746	4.9837	4.9558	4.9261	4.9054	4.8840	
util living area													
	0.9981	0.9949	0.9860	0.9563	0.8753	0.7143	0.5449	0.6002	0.8403	0.9737	0.9957	0.9986	(86)
MIT	19.6797	19.8619	20.1360	20.4843	20.7747	20.9427	20.9879	20.9809	20.8668	20.4803	20.0139	19.6520	(87)
Th 2	19.9153	19.9182	19.9210	19.9342	19.9367	19.9483	19.9483	19.9504	19.9438	19.9367	19.9317	19.9264	(88)
util rest of house													
	0.9974	0.9932	0.9810	0.9397	0.8286	0.6213	0.4219	0.4749	0.7660	0.9605	0.9939	0.9981	(89)
MIT 2	18.7162	18.8999	19.1736	19.5219	19.7859	19.9223	19.9453	19.9451	19.8712	19.5257	19.0627	18.6974	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9576	19.1409	19.4147	19.7630	20.0336	20.1779	20.2064	20.2046	20.1206	19.7648	19.3010	18.9366	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9576	19.1409	19.4147	19.7630	20.0336	20.1779	20.2064	20.2046	20.1206	19.7648	19.3010	18.9366	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9915	0.9779	0.9365	0.8335	0.6431	0.4530	0.5066	0.7803	0.9578	0.9925	0.9975	(94)
Useful gains	476.1018	570.1237	645.3286	690.7497	654.3246	494.8769	333.6060	348.6489	496.0974	529.3788	473.1133	446.2379	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1419.6719	1375.2111	1243.4988	1031.5520	789.2947	521.8546	337.4081	355.1306	565.9514	868.0156	1161.7019	1410.8543	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	702.0162	541.0187	445.0386	245.3777	100.4178	0.0000	0.0000	0.0000	0.0000	251.9458	495.7838	717.6746	(98)
Space heating												3499.2732	(98)
Space heating per m2											(98) / (4) =	43.5666	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	879.4390	692.3243	709.4107	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8784	0.9340	0.9137	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	772.5042	646.6565	648.1751	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	991.6866	951.0243	896.2899	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	157.8113	226.4497	184.5974	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												568.8584	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	39.4528	56.6124	46.1494	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.2146 (107)
Space cooling per m2												1.7706 (108)
Energy for space heating												43.5666 (99)
Energy for space cooling												1.7706 (108)
Total												45.3372 (109)
Target Fabric Energy Efficiency (TFEE)												52.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7300	
Infiltration rate			0.3810	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3700	0.3436	0.3524	0.3348	0.3348	0.3260	0.3172	0.3084	0.2996	0.3260	0.3084	0.3260	(22b)
Effective ac	0.5685	0.5590	0.5621	0.5560	0.5560	0.5531	0.5503	0.5475	0.5449	0.5531	0.5475	0.5531	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9494	38.3032	38.5133	38.0984	38.0984	37.8990	37.7049	37.5161	37.3326	37.8990	37.5161	37.8990	(38)
Heat transfer coeff	96.4366	95.7904	96.0005	95.5856	95.5856	95.3862	95.1920	95.0032	94.8197	95.3862	95.0032	95.3862	(39)
Average = Sum(39)m / 12 =												95.4646	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2007	1.1926	1.1952	1.1901	1.1901	1.1876	1.1852	1.1828	1.1805	1.1876	1.1828	1.1876	(40)
HLP (average)												1.1886	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	1.6400	45.1778	0.4600	0.0000	0.7700	26.2433	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	192.0961	283.9321	406.8851	533.8973	591.7527	649.2787	616.4806	560.5115	474.6611	342.9011	230.4803	160.8848	(83)
Total gains	747.9895	835.4809	937.0646	1030.9247	1054.8334	1081.9229	1031.3091	983.5756	916.7761	818.3801	743.0590	701.5352	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1582	34.3886	34.3134	34.4623	34.4623	34.5344	34.6048	34.6736	34.7407	34.5344	34.6736	34.5344	
alpha	3.2772	3.2926	3.2876	3.2975	3.2975	3.3023	3.3070	3.3116	3.3160	3.3023	3.3116	3.3023	
util living area	0.9505	0.9302	0.8824	0.7913	0.6593	0.4754	0.3520	0.3673	0.5865	0.8087	0.9181	0.9570	(86)
MIT	19.5645	19.7579	20.1168	20.5151	20.7998	20.9497	20.9860	20.9842	20.8977	20.5655	20.0363	19.5370	(87)
Th 2	19.9195	19.9259	19.9238	19.9280	19.9280	19.9300	19.9319	19.9338	19.9356	19.9300	19.9338	19.9300	(88)
util rest of house	0.9411	0.9174	0.8610	0.7542	0.6001	0.3954	0.2591	0.2710	0.5066	0.7653	0.9004	0.9486	(89)
MIT 2	18.0596	18.3374	18.8384	19.3788	19.7352	19.8952	19.9260	19.9270	19.8551	19.4604	18.7436	18.0282	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4366	18.6933	19.1587	19.6634	20.0019	20.1594	20.1915	20.1918	20.1163	19.7372	19.0674	18.4062	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2866	18.5433	19.0087	19.5134	19.8519	20.0094	20.0415	20.0418	19.9663	19.5872	18.9174	18.2562	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9221	0.8964	0.8391	0.7381	0.5956	0.4016	0.2688	0.2810	0.5090	0.7493	0.8791	0.9309	(94)
Useful gains	689.7443	748.9664	786.3325	760.8743	628.2704	434.4573	277.2604	276.3690	466.6515	613.2009	653.2451	653.0545	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1290.9553	1268.5773	1152.8374	957.1404	702.7317	449.2084	280.0064	279.4842	499.3480	780.9482	1046.6916	1264.4533	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	447.3010	349.1786	272.6797	141.3116	55.3992	0.0000	0.0000	0.0000	0.0000	124.8040	283.2815	454.8807	(98)

Space heating 2128.8363 (98)
RHI space heating demand 2129 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.7300	
Infiltration rate				0.3810	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4493	0.4405	0.4317	0.3877	0.3788	0.3348	0.3348	0.3260	0.3524	0.3788	0.3965	0.4141	(22b)
Effective ac	0.6009	0.5970	0.5932	0.5751	0.5718	0.5560	0.5560	0.5531	0.5621	0.5718	0.5786	0.5857	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771	(36)
Total fabric heat loss	(33) + (36) =	57.4872	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1752	40.9066	40.6433	39.4068	39.1754	38.0984	38.0984	37.8990	38.5133	39.1754	39.6435	40.1328	(38)
Heat transfer coeff	98.6624	98.3938	98.1305	96.8940	96.6626	95.5856	95.5856	95.3862	96.0005	96.6626	97.1306	97.6199	(39)
Average = Sum(39)m / 12 =												96.8928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2284	1.2250	1.2217	1.2063	1.2035	1.1901	1.1901	1.1876	1.1952	1.2035	1.2093	1.2154	(40)
HLP (average)												1.2063	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	711.5411	821.4929	912.3279	991.9812	1037.0520	1011.0780	968.9160	916.8843	863.1220	777.2758	699.8862	673.2846	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3876	33.4788	33.5686	33.9970	34.0783	34.4623	34.4623	34.5344	34.3134	34.0783	33.9141	33.7441	
alpha	3.2258	3.2319	3.2379	3.2665	3.2719	3.2975	3.2975	3.3023	3.2876	3.2719	3.2609	3.2496	
util living area													
	0.9610	0.9385	0.8996	0.8251	0.7086	0.5535	0.4179	0.4557	0.6573	0.8534	0.9398	0.9666	(86)
MIT	19.3681	19.6220	19.9788	20.3973	20.7202	20.9109	20.9733	20.9641	20.8376	20.4172	19.8219	19.3194	(87)
Th 2	19.8974	19.9000	19.9026	19.9149	19.9172	19.9280	19.9280	19.9300	19.9238	19.9172	19.9126	19.9077	(88)
util rest of house													
	0.9536	0.9272	0.8810	0.7928	0.6557	0.4762	0.3227	0.3586	0.5829	0.8189	0.9267	0.9601	(89)
MIT 2	17.7638	18.1272	18.6322	19.2145	19.6320	19.8583	19.9142	19.9101	19.7839	19.2579	18.4274	17.7007	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1657	18.5017	18.9695	19.5108	19.9046	20.1220	20.1795	20.1742	20.0478	19.5483	18.7767	18.1062	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0157	18.3517	18.8195	19.3608	19.7546	19.9720	20.0295	20.0242	19.8978	19.3983	18.6267	17.9562	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9362	0.9064	0.8584	0.7738	0.6470	0.4796	0.3320	0.3675	0.5810	0.7991	0.9063	0.9441	(94)
Useful gains	666.1156	744.5668	783.1850	767.5879	671.0079	484.8699	321.6705	336.9696	501.4670	621.1425	634.3317	635.6702	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.2223	1323.5624	1208.9188	1013.5839	778.5772	513.4848	327.8140	345.6958	556.5953	850.4655	1119.5947	1342.8771	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	511.2074	389.0850	316.7459	177.1171	80.0315	0.0000	0.0000	0.0000	0.0000	170.6163	349.3894	526.1619	(98)
Space heating												2520.3546	(98)
Space heating per m2											(98) / (4) =	31.3789	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2784.9222	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	511.2074	389.0850	316.7459	177.1171	80.0315	0.0000	0.0000	0.0000	0.0000	170.6163	349.3894	526.1619	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	564.8701	429.9282	349.9955	195.7095	88.4326	0.0000	0.0000	0.0000	0.0000	188.5263	386.0656	581.3944	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6937	89.6052	89.4403	89.0979	88.4989	87.3000	87.3000	87.3000	87.3000	89.0389	89.5180	89.7282	(217)
Fuel for water heating, kWh/month													
	185.1997	162.5838	169.1444	149.5465	145.5976	129.0595	121.2740	136.7748	137.7020	155.3191	166.6856	179.7869	(219)
Water heating fuel used												1838.6739	(219)
Annual totals kWh/year													
Space heating fuel - main system												2784.9222	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3833.9750	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2784.9222	3.4800	96.9153	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.6739	3.4800	63.9859	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	353.9360	13.1900	46.6842	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			176.7501	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5924	(257)
SAP value		91.7365	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2784.9222	0.2160	601.5432	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.6739	0.2160	397.1536	(264)
Space and water heating			998.6967	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			588.8834	(272)
CO2 emissions per m2			7.3300	(273)
EI value			93.7033	
EI rating			94	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8865 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8865 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7300	
Infiltration rate			0.3810	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3700	0.3436	0.3524	0.3348	0.3348	0.3260	0.3172	0.3084	0.2996	0.3260	0.3084	0.3260	(22b)
Effective ac	0.5685	0.5590	0.5621	0.5560	0.5560	0.5531	0.5503	0.5475	0.5449	0.5531	0.5475	0.5531	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9494	38.3032	38.5133	38.0984	38.0984	37.8990	37.7049	37.5161	37.3326	37.8990	37.5161	37.8990	(38)
Heat transfer coeff	96.4366	95.7904	96.0005	95.5856	95.5856	95.3862	95.1920	95.0032	94.8197	95.3862	95.0032	95.3862	(39)
Average = Sum(39)m / 12 =												95.4646	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2007	1.1926	1.1952	1.1901	1.1901	1.1876	1.1852	1.1828	1.1805	1.1876	1.1828	1.1876	(40)
HLP (average)												1.1886	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	1.6400	45.1778	0.4600	0.0000	0.7700	26.2433	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	192.0961	283.9321	406.8851	533.8973	591.7527	649.2787	616.4806	560.5115	474.6611	342.9011	230.4803	160.8848	(83)
Total gains	747.9895	835.4809	937.0646	1030.9247	1054.8334	1081.9229	1031.3091	983.5756	916.7761	818.3801	743.0590	701.5352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1582	34.3886	34.3134	34.4623	34.4623	34.5344	34.6048	34.6736	34.7407	34.5344	34.6736	34.5344	
alpha	3.2772	3.2926	3.2876	3.2975	3.2975	3.3023	3.3070	3.3116	3.3160	3.3023	3.3116	3.3023	
util living area													
	0.9505	0.9302	0.8824	0.7913	0.6593	0.4754	0.3520	0.3673	0.5865	0.8087	0.9181	0.9570	(86)
MIT	19.5645	19.7579	20.1168	20.5151	20.7998	20.9497	20.9860	20.9842	20.8977	20.5655	20.0363	19.5370	(87)
Th 2	19.9195	19.9259	19.9238	19.9280	19.9280	19.9300	19.9319	19.9338	19.9356	19.9300	19.9338	19.9300	(88)
util rest of house													
	0.9411	0.9174	0.8610	0.7542	0.6001	0.3954	0.2591	0.2710	0.5066	0.7653	0.9004	0.9486	(89)
MIT 2	18.0596	18.3374	18.8384	19.3788	19.7352	19.8952	19.9260	19.9270	19.8551	19.4604	18.7436	18.0282	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4366	18.6933	19.1587	19.6634	20.0019	20.1594	20.1915	20.1918	20.1163	19.7372	19.0674	18.4062	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2866	18.5433	19.0087	19.5134	19.8519	20.0094	20.0415	20.0418	19.9663	19.5872	18.9174	18.2562	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9221	0.8964	0.8391	0.7381	0.5956	0.4016	0.2688	0.2810	0.5090	0.7493	0.8791	0.9309	(94)
Useful gains	689.7443	748.9664	786.3325	760.8743	628.2704	434.4573	277.2604	276.3690	466.6515	613.2009	653.2451	653.0545	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1290.9553	1268.5773	1152.8374	957.1404	702.7317	449.2084	280.0064	279.4842	499.3480	780.9482	1046.6916	1264.4533	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	447.3010	349.1786	272.6797	141.3116	55.3992	0.0000	0.0000	0.0000	0.0000	124.8040	283.2815	454.8807	(98)
Space heating												2128.8363	(98)
Space heating per m2											(98) / (4) =	26.5044	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2352.3053	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	447.3010	349.1786	272.6797	141.3116	55.3992	0.0000	0.0000	0.0000	0.0000	124.8040	283.2815	454.8807	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	494.2552	385.8327	301.3035	156.1454	61.2146	0.0000	0.0000	0.0000	0.0000	137.9050	313.0182	502.6306	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6105	89.5338	89.3316	88.9182	88.2381	87.3000	87.3000	87.3000	87.3000	88.7893	89.3698	89.6398	(217)
Fuel for water heating, kWh/month													
	185.3716	162.7134	169.3502	149.8486	146.0280	129.0595	121.2740	136.7748	137.7020	155.7558	166.9620	179.9643	(219)
Water heating fuel used												1840.8043	(219)
Annual totals kWh/year													
Space heating fuel - main system												2352.3053	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3253.0685	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2352.3053	9.7400	229.1145	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.8043	9.7400	179.2943	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	353.9360	36.8500	130.4254	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			166.0037	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2352.3053	0.2160	508.0979	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.8043	0.2160	397.6137	(264)
Space and water heating			905.7117	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			417.8303	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2352.3053	1.2200	2869.8125	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.8043	1.2200	2245.7812	(264)
Space and water heating			5115.5937	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	353.9360	3.0700	1086.5837	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2229.6676	(272)
Primary energy kWh/m2/year			27.7598	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-186 kg (44.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 93	A 96
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£158	£176	-£18
Mains gas	£512	£417	£95
Space heating	£361	£361	£0
Water heating	£179	£102	£77
Lighting	£130	£130	£0
Generated (PV)	-£504	-£504	£0
Total cost of fuels	£166	£89	£77
Total cost of uses	£166	£89	£77
Delivered energy	41 kWh/m²	29 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	28 kWh/m²	15 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7300	
Infiltration rate			0.3810	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4493	0.4405	0.4317	0.3877	0.3788	0.3348	0.3348	0.3260	0.3524	0.3788	0.3965	0.4141	(22b)
Effective ac	0.6009	0.5970	0.5932	0.5751	0.5718	0.5560	0.5560	0.5531	0.5621	0.5718	0.5786	0.5857	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1752	40.9066	40.6433	39.4068	39.1754	38.0984	38.0984	37.8990	38.5133	39.1754	39.6435	40.1328	(38)
Heat transfer coeff	98.6624	98.3938	98.1305	96.8940	96.6626	95.5856	95.5856	95.3862	96.0005	96.6626	97.1306	97.6199	(39)
Average = Sum(39)m / 12 =												96.8928	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2284	1.2250	1.2217	1.2063	1.2035	1.1901	1.1901	1.1876	1.1952	1.2035	1.2093	1.2154	(40)
HLP (average)												1.2063	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input

	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)

Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341 (83)
Total gains	711.5411	821.4929	912.3279	991.9812	1037.0520	1011.0780	968.9160	916.8843	863.1220	777.2758	699.8862	673.2846 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.3876	33.4788	33.5686	33.9970	34.0783	34.4623	34.4623	34.5344	34.3134	34.0783	33.9141	33.7441	
alpha	3.2258	3.2319	3.2379	3.2665	3.2719	3.2975	3.2975	3.3023	3.2876	3.2719	3.2609	3.2496	
util living area	0.9610	0.9385	0.8996	0.8251	0.7086	0.5535	0.4179	0.4557	0.6573	0.8534	0.9398	0.9666	(86)
MIT	19.3681	19.6220	19.9788	20.3973	20.7202	20.9109	20.9733	20.9641	20.8376	20.4172	19.8219	19.3194	(87)
Th 2	19.8974	19.9000	19.9026	19.9149	19.9172	19.9280	19.9280	19.9300	19.9238	19.9172	19.9126	19.9077	(88)
util rest of house	0.9536	0.9272	0.8810	0.7928	0.6557	0.4762	0.3227	0.3586	0.5829	0.8189	0.9267	0.9601	(89)
MIT 2	17.7638	18.1272	18.6322	19.2145	19.6320	19.8583	19.9142	19.9101	19.7839	19.2579	18.4274	17.7007	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1657	18.5017	18.9695	19.5108	19.9046	20.1220	20.1795	20.1742	20.0478	19.5483	18.7767	18.1062	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0157	18.3517	18.8195	19.3608	19.7546	19.9720	20.0295	20.0242	19.8978	19.3983	18.6267	17.9562	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9362	0.9064	0.8584	0.7738	0.6470	0.4796	0.3320	0.3675	0.5810	0.7991	0.9063	0.9441	(94)
Useful gains	666.1156	744.5668	783.1850	767.5879	671.0079	484.8699	321.6705	336.9696	501.4670	621.1425	634.3317	635.6702	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1353.2223	1323.5624	1208.9188	1013.5839	778.5772	513.4848	327.8140	345.6958	556.5953	850.4655	1119.5947	1342.8771	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	511.2074	389.0850	316.7459	177.1171	80.0315	0.0000	0.0000	0.0000	0.0000	170.6163	349.3894	526.1619	(98)
Space heating												2520.3546	(98)
Space heating per m2											(98) / (4) =	31.3789	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2784.9222	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	511.2074	389.0850	316.7459	177.1171	80.0315	0.0000	0.0000	0.0000	0.0000	170.6163	349.3894	526.1619	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	564.8701	429.9282	349.9955	195.7095	88.4326	0.0000	0.0000	0.0000	0.0000	188.5263	386.0656	581.3944	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7860	89.8014	89.8249	89.8932	90.0196	87.3000	87.3000	87.3000	87.3000	89.4012	89.6589	89.8050	(217)
Fuel for water heating, kWh/month	157.7387	116.7297	90.9505	44.4777	15.1490	0.0000	0.0000	24.9065	50.0868	96.2649	134.0309	156.8173	(219)
Water heating fuel used												887.1521	(219)
Annual totals kWh/year													
Space heating fuel - main system												2784.9222	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												2932.4533	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2784.9222	3.4800	96.9153	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	887.1521	3.4800	30.8729	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	353.9360	13.1900	46.6842	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			150.2322	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5035	(257)
SAP value	92.9763	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2784.9222	0.2160	601.5432	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	887.1521	0.2160	191.6249	(264)
Space and water heating			793.1680	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			409.3047	(272)
CO2 emissions per m2			5.1000	(273)
EI value			95.6235	
EI rating			96	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.7300	
Infiltration rate		0.3810	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3524	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3700	0.3436	0.3524	0.3348	0.3348	0.3260	0.3172	0.3084	0.2996	0.3260	0.3084	0.3260	(22b)
Effective ac	0.5685	0.5590	0.5621	0.5560	0.5560	0.5531	0.5503	0.5475	0.5449	0.5531	0.5475	0.5531	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9494	38.3032	38.5133	38.0984	38.0984	37.8990	37.7049	37.5161	37.3326	37.8990	37.5161	37.8990	(38)
Heat transfer coeff	96.4366	95.7904	96.0005	95.5856	95.5856	95.3862	95.1920	95.0032	94.8197	95.3862	95.0032	95.3862	(39)
Average = Sum(39)m / 12 =												95.4646	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2007	1.1926	1.1952	1.1901	1.1901	1.1876	1.1852	1.1828	1.1805	1.1876	1.1828	1.1876	(40)
HLP (average)												1.1886	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)
Total heat required for water heating calculated for each month												
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3896 (H8)
Utilisation factor	0.5131 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-876.6189 (H17)

Solar input	-28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154 (63)
								Solar input (sum of months) = Sum(63)m =				-876.6189 (63)
Output from w/h												
	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042 (64)
								Total per year (kWh/year) = Sum(64)m =				771.1322 (64)
Heat gains from water heating, kWh/month												
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	1.6400	45.1778	0.4600	0.0000	0.7700	26.2433	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	192.0961	283.9321	406.8851	533.8973	591.7527	649.2787	616.4806	560.5115	474.6611	342.9011	230.4803	160.8848 (83)
Total gains	747.9895	835.4809	937.0646	1030.9247	1054.8334	1081.9229	1031.3091	983.5756	916.7761	818.3801	743.0590	701.5352 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1582	34.3886	34.3134	34.4623	34.4623	34.5344	34.6048	34.6736	34.7407	34.5344	34.6736	34.5344	
alpha	3.2772	3.2926	3.2876	3.2975	3.2975	3.3023	3.3070	3.3116	3.3160	3.3023	3.3116	3.3023	
util living area													
	0.9505	0.9302	0.8824	0.7913	0.6593	0.4754	0.3520	0.3673	0.5865	0.8087	0.9181	0.9570	(86)
MIT	19.5645	19.7579	20.1168	20.5151	20.7998	20.9497	20.9860	20.9842	20.8977	20.5655	20.0363	19.5370	(87)
Th 2	19.9195	19.9259	19.9238	19.9280	19.9280	19.9300	19.9319	19.9338	19.9356	19.9300	19.9338	19.9300	(88)
util rest of house													
	0.9411	0.9174	0.8610	0.7542	0.6001	0.3954	0.2591	0.2710	0.5066	0.7653	0.9004	0.9486	(89)
MIT 2	18.0596	18.3374	18.8384	19.3788	19.7352	19.8952	19.9260	19.9270	19.8551	19.4604	18.7436	18.0282	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4366	18.6933	19.1587	19.6634	20.0019	20.1594	20.1915	20.1918	20.1163	19.7372	19.0674	18.4062	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2866	18.5433	19.0087	19.5134	19.8519	20.0094	20.0415	20.0418	19.9663	19.5872	18.9174	18.2562	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9221	0.8964	0.8391	0.7381	0.5956	0.4016	0.2688	0.2810	0.5090	0.7493	0.8791	0.9309	(94)
Useful gains	689.7443	748.9664	786.3325	760.8743	628.2704	434.4573	277.2604	276.3690	466.6515	613.2009	653.2451	653.0545	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1290.9553	1268.5773	1152.8374	957.1404	702.7317	449.2084	280.0064	279.4842	499.3480	780.9482	1046.6916	1264.4533	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	447.3010	349.1786	272.6797	141.3116	55.3992	0.0000	0.0000	0.0000	0.0000	124.8040	283.2815	454.8807	(98)
Space heating												2128.8363	(98)
Space heating per m2											(98) / (4) =	26.5044	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2352.3053	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	447.3010	349.1786	272.6797	141.3116	55.3992	0.0000	0.0000	0.0000	0.0000	124.8040	283.2815	454.8807	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	494.2552	385.8327	301.3035	156.1454	61.2146	0.0000	0.0000	0.0000	0.0000	137.9050	313.0182	502.6306	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7266	89.7394	89.7438	89.7889	89.6907	87.3000	87.3000	87.3000	87.3000	89.2018	89.5499	89.7352	(217)
Fuel for water heating, kWh/month	153.2600	117.0275	90.6938	43.3721	20.1716	0.0000	0.0000	18.0306	44.7335	92.1306	128.8559	153.5676	(219)
Water heating fuel used												861.8433	(219)
Annual totals kWh/year													
Space heating fuel - main system												2352.3053	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2324.1076	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2352.3053	9.7400	229.1145	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.8433	9.7400	83.9435	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	353.9360	36.8500	130.4254	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			89.0779	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2352.3053	0.2160	508.0979	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.8433	0.2160	186.1582	(264)
Space and water heating			694.2561	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			232.3248 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2352.3053	1.2200	2869.8125	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.8433	1.2200	1051.4488	(264)
Space and water heating			3921.2613	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	353.9360	3.0700	1086.5837	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1188.8352	(272)
Primary energy kWh/m2/year			14.8012	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		274.07 (P1)
Transmission heat loss coefficient		57.49 (37)
Summer heat loss coefficient		331.56 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	98.8453	0.4600	0.0000	0.9000	148.5466
South East	1.6400	119.9223	0.4600	0.0000	0.9000	81.4225
South West	4.6800	119.9223	0.4600	0.0000	0.9000	232.3519
South West	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						686.2329

	Jun	Jul	Aug	
Solar gains	725	686	623	(P4)
Internal gains	430	412	420	
Total summer gains	1154	1098	1043	(P5)
Summer gain/loss ratio	3.48	3.31	3.15	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.6)	0.97	0.97	0.97	
Threshold temperature	20.45	22.18	21.91	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-345	**Issued on Date**	19/04/2023
Assessment Reference	As Built	**Prop Type Ref**	2-As-SEMI
Property	11, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.32	**TER**	19.07
Environmental	92 A	**% DER<TER**	45.88		
CO_2 Emissions (t/year)	0.54	**DFEE**	47.64	**TFEE**	56.13
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.13		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.07 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.32 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.48 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 3.63 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4346	0.4261	0.4175	0.3749	0.3664	0.3238	0.3238	0.3153	0.3409	0.3664	0.3835	0.4005	(22b)
Effective ac	0.5944	0.5908	0.5872	0.5703	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7288	40.4775	40.2312	39.0745	38.8581	37.8506	37.8506	37.6640	38.2387	38.8581	39.2959	39.7536	(38)
Heat transfer coeff	99.1969	98.9457	98.6994	97.5426	97.3262	96.3187	96.3187	96.1322	96.7068	97.3262	97.7640	98.2218	(39)
Average = Sum(39)m / 12 =												97.5416	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2350	1.2319	1.2288	1.2144	1.2117	1.1992	1.1992	1.1969	1.2040	1.2117	1.2172	1.2229	(40)
HLP (average)												1.2144	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	474.1158	565.7792	677.5414	805.7592	894.9536	890.3713	846.6425	768.5484	668.4888	548.2108	468.0202	445.4253	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0861	33.1702	33.2529	33.6473	33.7221	34.0748	34.0748	34.1409	33.9381	33.7221	33.5711	33.4146	
alpha	3.2057	3.2113	3.2169	3.2432	3.2481	3.2717	3.2717	3.2761	3.2625	3.2481	3.2381	3.2276	
util living area													
	0.9870	0.9765	0.9504	0.8853	0.7689	0.6116	0.4732	0.5313	0.7647	0.9325	0.9790	0.9893	(86)
MIT	18.9861	19.2355	19.6640	20.2045	20.6301	20.8770	20.9603	20.9420	20.7334	20.1459	19.4666	18.9442	(87)
Th 2	19.8921	19.8946	19.8970	19.9085	19.9106	19.9207	19.9207	19.9225	19.9168	19.9106	19.9063	19.9017	(88)
util rest of house													
	0.9842	0.9715	0.9397	0.8604	0.7196	0.5313	0.3679	0.4233	0.6956	0.9124	0.9737	0.9870	(89)
MIT 2	17.2119	17.5749	18.1928	18.9589	19.5234	19.8219	19.8997	19.8891	19.6728	18.8970	17.9209	17.1567	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6563	17.9909	18.5613	19.2709	19.8006	20.0862	20.1654	20.1529	19.9385	19.2098	18.3081	17.6045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5063	17.8409	18.4113	19.1209	19.6506	19.9362	20.0154	20.0029	19.7885	19.0598	18.1581	17.4545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9751	0.9581	0.9202	0.8384	0.7063	0.5326	0.3776	0.4318	0.6862	0.8916	0.9612	0.9791	(94)
Useful gains	462.3165	542.0960	623.4911	675.5329	632.1146	474.1680	319.6734	331.8975	458.7081	488.7657	449.8548	436.1319	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1310.0228	1280.4441	1175.6407	996.9782	773.8032	513.9756	328.9642	346.3503	550.1168	823.3619	1081.0854	1301.8779	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	630.6934	496.1699	410.7993	231.4407	105.4163	0.0000	0.0000	0.0000	0.0000	248.9396	454.4860	644.1151	(98)
Space heating												3222.0604	(98)
Space heating per m2											(98) / (4) =	40.1153	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3560.2877	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	630.6934	496.1699	410.7993	231.4407	105.4163	0.0000	0.0000	0.0000	0.0000	248.9396	454.4860	644.1151	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	696.8988	548.2541	453.9219	255.7356	116.4821	0.0000	0.0000	0.0000	0.0000	275.0714	502.1945	711.7293	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8137	89.7533	89.6159	89.3040	88.7115	87.3000	87.3000	87.3000	87.3000	89.3306	89.6874	89.8404	(217)
Fuel for water heating, kWh/month													
	184.9523	162.3156	168.8130	149.2013	145.2488	129.0595	121.2740	136.7748	137.7020	154.8119	166.3707	179.5624	(219)
Water heating fuel used												1836.0863	(219)
Annual totals kWh/year													
Space heating fuel - main system												3560.2877	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4747.5207	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3560.2877	0.2160	769.0221	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.0863	0.2160	396.5946	(264)
Space and water heating			1165.6168	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			828.8619	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.3200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.3200	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		28.7783	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7783	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9281	(36)
Total fabric heat loss	(33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	84.9765	165.8696	273.9672	403.4177	499.4928	513.9622	488.2012	415.6590	319.6591	196.8763	105.8493	69.9712	(83)
Total gains	472.7995	551.3367	645.2925	752.3116	825.6082	818.1045	778.4800	712.5395	628.3697	528.2303	463.1269	446.4994	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9982	0.9958	0.9874	0.9541	0.8601	0.6881	0.5235	0.5881	0.8484	0.9783	0.9962	0.9986	(86)
MIT	19.6554	19.8169	20.1035	20.4840	20.7897	20.9499	20.9894	20.9818	20.8566	20.4430	19.9827	19.6323	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9975	0.9943	0.9828	0.9368	0.8102	0.5944	0.4031	0.4633	0.7753	0.9671	0.9947	0.9981	(89)
MIT 2	18.1158	18.3534	18.7714	19.3207	19.7223	19.9043	19.9331	19.9317	19.8171	19.2746	18.6056	18.0897	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5015	18.7200	19.1051	19.6121	19.9897	20.1662	20.1977	20.1947	20.0775	19.5673	18.9506	18.4761	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5015	18.7200	19.1051	19.6121	19.9897	20.1662	20.1977	20.1947	20.0775	19.5673	18.9506	18.4761	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9920	0.9781	0.9305	0.8136	0.6159	0.4334	0.4946	0.7868	0.9620	0.9926	0.9971	(94)
Useful gains	471.0325	546.9069	631.1562	700.0352	671.7431	503.8879	337.3942	352.4276	494.4068	508.1559	459.6785	445.2247	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1391.6717	1350.3103	1228.0500	1029.4260	794.5740	527.0999	340.6861	358.5366	568.7087	859.5202	1141.8340	1383.0331	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	684.9556	539.8871	444.0890	237.1613	91.3862	0.0000	0.0000	0.0000	0.0000	261.4151	491.1520	697.7295	(98)
Space heating												3447.7757	(98)
Space heating per m2											(98) / (4) =	42.9255	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3691.4087	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	684.9556	539.8871	444.0890	237.1613	91.3862	0.0000	0.0000	0.0000	0.0000	261.4151	491.1520	697.7295	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	733.3571	578.0375	475.4700	253.9201	97.8439	0.0000	0.0000	0.0000	0.0000	279.8877	525.8587	747.0337	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8788	87.6688	87.1763	85.9786	83.7164	80.3000	80.3000	80.3000	80.3000	86.1025	87.4087	87.9581	(217)
Fuel for water heating, kWh/month													
	230.3173	202.7465	212.1364	190.7754	189.6952	174.1812	166.8789	186.0308	188.0853	199.7394	210.0317	224.6769	(219)
Water heating fuel used												2375.2950	(219)
Annual totals kWh/year													
Space heating fuel - main system												3691.4087	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6492.7499	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3691.4087	0.2160	797.3443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2375.2950	0.2160	513.0637	(264)
Space and water heating			1310.4080	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1531.5259	(272)
Emissions per m2 for space and water heating			16.3148	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3148 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			19.0700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3685	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4346	0.4261	0.4175	0.3749	0.3664	0.3238	0.3238	0.3153	0.3409	0.3664	0.3835	0.4005	(22b)
Effective ac	0.5944	0.5908	0.5872	0.5703	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7288	40.4775	40.2312	39.0745	38.8581	37.8506	37.8506	37.6640	38.2387	38.8581	39.2959	39.7536	(38)
Heat transfer coeff	99.1969	98.9457	98.6994	97.5426	97.3262	96.3187	96.3187	96.1322	96.7068	97.3262	97.7640	98.2218	(39)
Average = Sum(39)m / 12 =												97.5416	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2350	1.2319	1.2288	1.2144	1.2117	1.1992	1.1992	1.1969	1.2040	1.2117	1.2172	1.2229	(40)
HLP (average)												1.2144	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	441.7599	534.2045	647.5889	778.0092	868.6345	866.0644	824.0422	743.7575	642.9167	520.3597	437.5951	413.8450	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0861	33.1702	33.2529	33.6473	33.7221	34.0748	34.0748	34.1409	33.9381	33.7221	33.5711	33.4146	
alpha	3.2057	3.2113	3.2169	3.2432	3.2481	3.2717	3.2717	3.2761	3.2625	3.2481	3.2381	3.2276	
util living area													
	0.9894	0.9799	0.9557	0.8936	0.7801	0.6237	0.4842	0.5453	0.7794	0.9405	0.9826	0.9913	(86)
MIT	18.9337	19.1863	19.6216	20.1738	20.6121	20.8696	20.9575	20.9373	20.7161	20.1087	19.4186	18.8925	(87)
Th 2	19.8921	19.8946	19.8970	19.9085	19.9106	19.9207	19.9207	19.9225	19.9168	19.9106	19.9063	19.9017	(88)
util rest of house													
	0.9871	0.9756	0.9460	0.8700	0.7318	0.5432	0.3772	0.4358	0.7120	0.9224	0.9781	0.9895	(89)
MIT 2	18.0103	18.2625	18.6926	19.2323	19.6320	19.8487	19.9052	19.8977	19.7378	19.1841	18.5036	17.9763	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2416	18.4939	18.9253	19.4681	19.8775	20.1044	20.1688	20.1581	19.9829	19.4157	18.7328	18.2058	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2416	18.4939	18.9253	19.4681	19.8775	20.1044	20.1688	20.1581	19.9829	19.4157	18.7328	18.2058	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9683	0.9351	0.8587	0.7301	0.5578	0.4029	0.4612	0.7166	0.9119	0.9716	0.9854	(94)
Useful gains	433.9472	517.2598	605.5622	668.0928	634.2248	483.1093	331.9971	342.9966	460.7423	474.5347	425.1605	407.8146	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1382.9653	1345.0567	1226.3732	1030.8414	795.8835	530.1788	343.7463	361.2751	568.9120	857.9973	1137.2700	1375.6757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	706.0695	556.2795	461.8834	261.1790	120.2741	0.0000	0.0000	0.0000	0.0000	285.2962	512.7188	720.0886	(98)
Space heating												3623.7891	(98)
Space heating per m2											(98) / (4) =	45.1169	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	905.3961	712.7586	730.6044	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8356	0.8890	0.8585	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	756.5219	633.6359	627.2601	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1104.4372	1053.4195	961.1492	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	250.4990	312.3190	248.4135	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												811.2316	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	62.6248	78.0798	62.1034	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												202.8079	(107)
Space cooling per m2												2.5250	(108)
Energy for space heating												45.1169	(99)
Energy for space cooling												2.5250	(108)
Total												47.6419	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	84.9765	165.8696	273.9672	403.4177	499.4928	513.9622	488.2012	415.6590	319.6591	196.8763	105.8493	69.9712	(83)
Total gains	428.2502	507.8342	604.0330	713.8730	789.2241	784.3536	746.4269	677.6752	592.0966	489.0599	420.7670	402.7208	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9988	0.9970	0.9904	0.9619	0.8762	0.7097	0.5438	0.6137	0.8706	0.9840	0.9975	0.9991	(86)
MIT	19.6044	19.7676	20.0585	20.4480	20.7681	20.9426	20.9875	20.9782	20.8362	20.4018	19.9344	19.5819	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9984	0.9960	0.9868	0.9471	0.8295	0.6159	0.4198	0.4856	0.8027	0.9754	0.9965	0.9988	(89)
MIT 2	18.6322	18.7972	19.0884	19.4785	19.7701	19.9110	19.9338	19.9329	19.8399	19.4418	18.9747	18.6185	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.8757	19.0403	19.3314	19.7214	20.0201	20.1694	20.1977	20.1947	20.0894	19.6823	19.2151	18.8599	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8757	19.0403	19.3314	19.7214	20.0201	20.1694	20.1977	20.1947	20.0894	19.6823	19.2151	18.8599	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9842	0.9436	0.8342	0.6380	0.4512	0.5181	0.8145	0.9728	0.9955	0.9984	(94)
Useful gains	427.3189	505.2091	594.5006	673.6110	658.3806	500.3805	336.7678	351.0718	482.2333	475.7561	418.8719	402.0719	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1428.3491	1381.6063	1250.0984	1039.9234	797.4928	527.3991	340.6906	358.5339	569.8427	870.5437	1167.3266	1420.2094	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	744.7665	588.9389	487.7647	263.7450	103.4995	0.0000	0.0000	0.0000	0.0000	293.7220	538.8874	757.4943	(98)
Space heating												3778.8183	(98)
Space heating per m2											(98) / (4) =	47.0470	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8788	0.9329	0.9051	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	782.2537	653.7109	649.8984	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1008.9310	962.7004	883.9101	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.2077	229.8882	174.1047	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												567.2005	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   40.8019   57.4720   43.5262    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        141.8001 (107)
Space cooling per m2                                                                                                   1.7654 (108)
Energy for space heating                                                                                              47.0470 (99)
Energy for space cooling                                                                                               1.7654 (108)
Total                                                                                                                 48.8125 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   56.1 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3579	0.3323	0.3409	0.3238	0.3238	0.3153	0.3068	0.2982	0.2897	0.3153	0.2982	0.3153	(22b)
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5471	0.5445	0.5420	0.5497	0.5445	0.5497	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6466	38.0421	38.2387	37.8506	37.8506	37.6640	37.4824	37.3058	37.1342	37.6640	37.3058	37.6640	(38)
Heat transfer coeff	97.1148	96.5103	96.7068	96.3187	96.3187	96.1322	95.9506	95.7739	95.6023	96.1322	95.7739	96.1322	(39)
Average = Sum(39)m / 12 =												96.2055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2091	1.2016	1.2040	1.1992	1.1992	1.1969	1.1946	1.1924	1.1903	1.1969	1.1924	1.1969	(40)
HLP (average)												1.1978	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.1921	209.7645	348.8462	515.2027	604.5648	674.9059	636.3898	556.4853	429.4096	268.5729	156.7235	102.1052 (83)
Total gains	681.6764	760.9499	878.7301	1012.0063	1067.4784	1107.4089	1051.0657	979.3511	871.2584	743.7141	668.9078	642.3352 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7955	34.0072	33.9381	34.0748	34.0748	34.1409	34.2056	34.2686	34.3302	34.1409	34.2686	34.1409	
alpha	3.2530	3.2671	3.2625	3.2717	3.2717	3.2761	3.2804	3.2846	3.2887	3.2761	3.2846	3.2761	
util living area	0.9610	0.9446	0.8982	0.7992	0.6563	0.4686	0.3482	0.3713	0.6115	0.8412	0.9366	0.9659	(86)
MIT	19.4501	19.6386	20.0355	20.4888	20.7980	20.9503	20.9859	20.9830	20.8809	20.4912	19.9236	19.4293	(87)
Th 2	19.9127	19.9187	19.9168	19.9207	19.9207	19.9225	19.9243	19.9261	19.9278	19.9225	19.9261	19.9225	(88)
util rest of house	0.9533	0.9340	0.8788	0.7627	0.5969	0.3890	0.2556	0.2734	0.5303	0.8018	0.9220	0.9590	(89)
MIT 2	17.8934	18.1658	18.7236	19.3399	19.7264	19.8883	19.9184	19.9189	19.8330	19.3635	18.5833	17.8705	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2834	18.5347	19.0522	19.6277	19.9948	20.1543	20.1858	20.1854	20.0955	19.6460	18.9190	18.2610	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1334	18.3847	18.9022	19.4777	19.8448	20.0043	20.0358	20.0354	19.9455	19.4960	18.7690	18.1110	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9360	0.9142	0.8565	0.7457	0.5924	0.3952	0.2654	0.2837	0.5318	0.7832	0.9016	0.9429	(94)
Useful gains	638.0463	695.6333	752.6702	754.6913	632.3879	437.6924	278.9374	277.7977	463.3058	582.5025	603.0783	605.6687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1285.1572	1262.8104	1151.0229	961.0397	707.4408	452.2389	281.6912	281.1376	501.4819	778.2823	1040.9690	1260.3877	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	481.4505	381.1430	296.3744	148.5709	55.8394	0.0000	0.0000	0.0000	0.0000	145.6602	315.2813	487.1110	(98)

Space heating 2311.4306 (98)
RHI space heating demand 2311 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4346	0.4261	0.4175	0.3749	0.3664	0.3238	0.3238	0.3153	0.3409	0.3664	0.3835	0.4005	(22b)
Effective ac	0.5944	0.5908	0.5872	0.5703	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7288	40.4775	40.2312	39.0745	38.8581	37.8506	37.8506	37.6640	38.2387	38.8581	39.2959	39.7536	(38)
Heat transfer coeff	99.1969	98.9457	98.6994	97.5426	97.3262	96.3187	96.3187	96.1322	96.7068	97.3262	97.7640	98.2218	(39)
Average = Sum(39)m / 12 =												97.5416	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2350	1.2319	1.2288	1.2144	1.2117	1.1992	1.1992	1.1969	1.2040	1.2117	1.2172	1.2229	(40)
HLP (average)												1.2144	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	653.9706	743.4253	847.4070	964.3575	1041.8167	1028.1759	980.4924	904.6071	812.3279	703.3172	634.8618	621.3254	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0861	33.1702	33.2529	33.6473	33.7221	34.0748	34.0748	34.1409	33.9381	33.7221	33.5711	33.4146	
alpha	3.2057	3.2113	3.2169	3.2432	3.2481	3.2717	3.2717	3.2761	3.2625	3.2481	3.2381	3.2276	
util living area													
	0.9686	0.9519	0.9151	0.8350	0.7083	0.5488	0.4160	0.4637	0.6854	0.8812	0.9528	0.9729	(86)
MIT	19.2665	19.4987	19.8873	20.3611	20.7150	20.9108	20.9728	20.9611	20.8112	20.3309	19.7164	19.2227	(87)
Th 2	19.8921	19.8946	19.8970	19.9085	19.9106	19.9207	19.9207	19.9225	19.9168	19.9106	19.9063	19.9017	(88)
util rest of house													
	0.9624	0.9426	0.8986	0.8036	0.6553	0.4714	0.3205	0.3648	0.6113	0.8509	0.9421	0.9676	(89)
MIT 2	17.6158	17.9502	18.5031	19.1629	19.6200	19.8511	19.9067	19.9009	19.7518	19.1423	18.2759	17.5589	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0293	18.3381	18.8499	19.4631	19.8943	20.1165	20.1738	20.1665	20.0172	19.4400	18.6367	17.9756	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8793	18.1881	18.6999	19.3131	19.7443	19.9665	20.0238	20.0165	19.8672	19.2900	18.4867	17.8256	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9467	0.9234	0.8762	0.7838	0.6465	0.4749	0.3300	0.3738	0.6076	0.8297	0.9232	0.9532	(94)
Useful gains	619.1174	686.4943	742.4745	755.8219	673.4865	488.2885	323.5193	338.1722	493.5522	583.5258	586.0797	592.2207	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1347.0223	1314.7996	1204.1191	1015.7165	782.9223	516.8988	329.7721	347.6628	557.7290	845.7697	1113.2109	1338.3338	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	541.5613	422.2212	343.4636	187.1241	81.4202	0.0000	0.0000	0.0000	0.0000	195.1095	379.5345	555.1082	(98)
Space heating												2705.5425	(98)
Space heating per m2											(98) / (4) =	33.6845	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2989.5498	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	541.5613	422.2212	343.4636	187.1241	81.4202	0.0000	0.0000	0.0000	0.0000	195.1095	379.5345	555.1082	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	598.4103	466.5427	379.5178	206.7670	89.9671	0.0000	0.0000	0.0000	0.0000	215.5906	419.3752	613.3792	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7280	89.6569	89.4969	89.1410	88.5119	87.3000	87.3000	87.3000	87.3000	89.1446	89.5734	89.7592	(217)
Fuel for water heating, kWh/month													
	185.1289	162.4900	169.0374	149.4741	145.5764	129.0595	121.2740	136.7748	137.7020	155.1349	166.5824	179.7250	(219)
Water heating fuel used												1837.9594	(219)
Annual totals kWh/year													
Space heating fuel - main system												2989.5498	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4178.6559	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2989.5498	3.4800	104.0363	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1837.9594	3.4800	63.9610	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			202.4136	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6784	(257)
SAP value		90.5367	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2989.5498	0.2160	645.7428	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1837.9594	0.2160	396.9992	(264)
Space and water heating			1042.7420	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			705.9871	(272)
CO2 emissions per m2			8.7900	(273)
EI value			92.4511	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3579	0.3323	0.3409	0.3238	0.3238	0.3153	0.3068	0.2982	0.2897	0.3153	0.2982	0.3153	(22b)
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5471	0.5445	0.5420	0.5497	0.5445	0.5497	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6466	38.0421	38.2387	37.8506	37.8506	37.6640	37.4824	37.3058	37.1342	37.6640	37.3058	37.6640	(38)
Heat transfer coeff	97.1148	96.5103	96.7068	96.3187	96.3187	96.1322	95.9506	95.7739	95.6023	96.1322	95.7739	96.1322	(39)
Average = Sum(39)m / 12 =												96.2055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2091	1.2016	1.2040	1.1992	1.1992	1.1969	1.1946	1.1924	1.1903	1.1969	1.1924	1.1969	(40)
HLP (average)												1.1978	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.1921	209.7645	348.8462	515.2027	604.5648	674.9059	636.3898	556.4853	429.4096	268.5729	156.7235	102.1052	(83)
Total gains	681.6764	760.9499	878.7301	1012.0063	1067.4784	1107.4089	1051.0657	979.3511	871.2584	743.7141	668.9078	642.3352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7955	34.0072	33.9381	34.0748	34.0748	34.1409	34.2056	34.2686	34.3302	34.1409	34.2686	34.1409	
alpha	3.2530	3.2671	3.2625	3.2717	3.2717	3.2761	3.2804	3.2846	3.2887	3.2761	3.2846	3.2761	
util living area													
	0.9610	0.9446	0.8982	0.7992	0.6563	0.4686	0.3482	0.3713	0.6115	0.8412	0.9366	0.9659	(86)
MIT	19.4501	19.6386	20.0355	20.4888	20.7980	20.9503	20.9859	20.9830	20.8809	20.4912	19.9236	19.4293	(87)
Th 2	19.9127	19.9187	19.9168	19.9207	19.9207	19.9225	19.9243	19.9261	19.9278	19.9225	19.9261	19.9225	(88)
util rest of house													
	0.9533	0.9340	0.8788	0.7627	0.5969	0.3890	0.2556	0.2734	0.5303	0.8018	0.9220	0.9590	(89)
MIT 2	17.8934	18.1658	18.7236	19.3399	19.7264	19.8883	19.9184	19.9189	19.8330	19.3635	18.5833	17.8705	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2834	18.5347	19.0522	19.6277	19.9948	20.1543	20.1858	20.1854	20.0955	19.6460	18.9190	18.2610	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1334	18.3847	18.9022	19.4777	19.8448	20.0043	20.0358	20.0354	19.9455	19.4960	18.7690	18.1110	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9360	0.9142	0.8565	0.7457	0.5924	0.3952	0.2654	0.2837	0.5318	0.7832	0.9016	0.9429	(94)
Useful gains	638.0463	695.6333	752.6702	754.6913	632.3879	437.6924	278.9374	277.7977	463.3058	582.5025	603.0783	605.6687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1285.1572	1262.8104	1151.0229	961.0397	707.4408	452.2389	281.6912	281.1376	501.4819	778.2823	1040.9690	1260.3877	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	481.4505	381.1430	296.3744	148.5709	55.8394	0.0000	0.0000	0.0000	0.0000	145.6602	315.2813	487.1110	(98)
Space heating												2311.4306	(98)
Space heating per m2											(98) / (4) =	28.7778	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2554.0670	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	481.4505	381.1430	296.3744	148.5709	55.8394	0.0000	0.0000	0.0000	0.0000	145.6602	315.2813	487.1110	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	531.9895	421.1524	327.4855	164.1667	61.7010	0.0000	0.0000	0.0000	0.0000	160.9505	348.3772	538.2442	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6570	89.5919	89.3927	88.9583	88.2434	87.3000	87.3000	87.3000	87.3000	88.9127	89.4468	89.6822	(217)
Fuel for water heating, kWh/month													
	185.2755	162.6080	169.2345	149.7812	146.0193	129.0595	121.2740	136.7748	137.7020	155.5395	166.8184	179.8793	(219)
Water heating fuel used												1839.9660	(219)
Annual totals kWh/year													
Space heating fuel - main system												2554.0670	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3599.3544	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2554.0670	9.7400	248.7661	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1839.9660	9.7400	179.2127	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			239.1398	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2554.0670	0.2160	551.6785	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1839.9660	0.2160	397.4327	(264)
Space and water heating			949.1111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			536.6730	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2554.0670	1.2200	3115.9617	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1839.9660	1.2200	2244.7585	(264)
Space and water heating			5360.7202	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2921.0571	(272)
Primary energy kWh/m2/year			36.3677	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (34.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 92	A 94
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£157	£175	-£18
Mains gas	£532	£437	£95
Space heating	£380	£380	£0
Water heating	£179	£102	£77
Lighting	£129	£129	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£239	£162	£77
Total cost of uses	£238	£161	£77
Delivered energy	45 kWh/m²	33 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	36 kWh/m²	23 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4800	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4346	0.4261	0.4175	0.3749	0.3664	0.3238	0.3238	0.3153	0.3409	0.3664	0.3835	0.4005	(22b)
Effective ac	0.5944	0.5908	0.5872	0.5703	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7288	40.4775	40.2312	39.0745	38.8581	37.8506	37.8506	37.6640	38.2387	38.8581	39.2959	39.7536	(38)
Heat transfer coeff	99.1969	98.9457	98.6994	97.5426	97.3262	96.3187	96.3187	96.1322	96.7068	97.3262	97.7640	98.2218	(39)
Average = Sum(39)m / 12 =												97.5416	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2350	1.2319	1.2288	1.2144	1.2117	1.1992	1.1992	1.1969	1.2040	1.2117	1.2172	1.2229	(40)
HLP (average)												1.2144	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
											Solar input (sum of months) = Sum(63)m =	-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
											Total per year (kWh/year) = Sum(64)m =	794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	653.9706	743.4253	847.4070	964.3575	1041.8167	1028.1759	980.4924	904.6071	812.3279	703.3172	634.8618	621.3254	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0861	33.1702	33.2529	33.6473	33.7221	34.0748	34.0748	34.1409	33.9381	33.7221	33.5711	33.4146	
alpha	3.2057	3.2113	3.2169	3.2432	3.2481	3.2717	3.2717	3.2761	3.2625	3.2481	3.2381	3.2276	
util living area													
	0.9686	0.9519	0.9151	0.8350	0.7083	0.5488	0.4160	0.4637	0.6854	0.8812	0.9528	0.9729	(86)
MIT	19.2665	19.4987	19.8873	20.3611	20.7150	20.9108	20.9728	20.9611	20.8112	20.3309	19.7164	19.2227	(87)
Th 2	19.8921	19.8946	19.8970	19.9085	19.9106	19.9207	19.9207	19.9225	19.9168	19.9106	19.9063	19.9017	(88)
util rest of house													
	0.9624	0.9426	0.8986	0.8036	0.6553	0.4714	0.3205	0.3648	0.6113	0.8509	0.9421	0.9676	(89)
MIT 2	17.6158	17.9502	18.5031	19.1629	19.6200	19.8511	19.9067	19.9009	19.7518	19.1423	18.2759	17.5589	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.0293	18.3381	18.8499	19.4631	19.8943	20.1165	20.1738	20.1665	20.0172	19.4400	18.6367	17.9756	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8793	18.1881	18.6999	19.3131	19.7443	19.9665	20.0238	20.0165	19.8672	19.2900	18.4867	17.8256	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9467	0.9234	0.8762	0.7838	0.6465	0.4749	0.3300	0.3738	0.6076	0.8297	0.9232	0.9532	(94)
Useful gains	619.1174	686.4943	742.4745	755.8219	673.4865	488.2885	323.5193	338.1722	493.5522	583.5258	586.0797	592.2207	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1347.0223	1314.7996	1204.1191	1015.7165	782.9223	516.8988	329.7721	347.6628	557.7290	845.7697	1113.2109	1338.3338	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	541.5613	422.2212	343.4636	187.1241	81.4202	0.0000	0.0000	0.0000	0.0000	195.1095	379.5345	555.1082	(98)
Space heating												2705.5425	(98)
Space heating per m2											(98) / (4) =	33.6845	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2989.5498	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	541.5613	422.2212	343.4636	187.1241	81.4202	0.0000	0.0000	0.0000	0.0000	195.1095	379.5345	555.1082	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	598.4103	466.5427	379.5178	206.7670	89.9671	0.0000	0.0000	0.0000	0.0000	215.5906	419.3752	613.3792	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8175	89.8450	89.8670	89.9197	90.0266	87.3000	87.3000	87.3000	87.3000	89.4959	89.7092	89.8337	(217)
Fuel for water heating, kWh/month	157.6834	116.6730	90.9079	44.4646	15.1479	0.0000	0.0000	24.9065	50.0868	96.1631	133.9558	156.7672	(219)
Water heating fuel used												886.7562	(219)
Annual totals kWh/year													
Space heating fuel - main system												2989.5498	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3277.4527	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2989.5498	3.4800	104.0363	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.7562	3.4800	30.8591	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			175.9067	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5895	(257)
SAP value	91.7760	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2989.5498	0.2160	645.7428	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.7562	0.2160	191.5393	(264)
Space and water heating			837.2821	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			526.4772	(272)
CO2 emissions per m2			6.5500	(273)
EI value			94.3706	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.4800	
Infiltration rate			0.3685	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3579	0.3323	0.3409	0.3238	0.3238	0.3153	0.3068	0.2982	0.2897	0.3153	0.2982	0.3153	(22b)
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5471	0.5445	0.5420	0.5497	0.5445	0.5497	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6466	38.0421	38.2387	37.8506	37.8506	37.6640	37.4824	37.3058	37.1342	37.6640	37.3058	37.6640	(38)
Heat transfer coeff	97.1148	96.5103	96.7068	96.3187	96.3187	96.1322	95.9506	95.7739	95.6023	96.1322	95.7739	96.1322	(39)
Average = Sum(39)m / 12 =												96.2055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2091	1.2016	1.2040	1.1992	1.1992	1.1969	1.1946	1.1924	1.1903	1.1969	1.1924	1.1969	(40)
HLP (average)												1.1978	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3896	(H8)
Utilisation factor												0.5131	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-876.6189	(H17)
Solar input -28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154	(63)	
									Solar input (sum of months) = Sum(63)m =		-876.6189	(63)	
Output from w/h													
137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)	
									Total per year (kWh/year) = Sum(64)m =		771.1322	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	13.4839	0.4600	0.0000	0.7700	11.7967	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.1921	209.7645	348.8462	515.2027	604.5648	674.9059	636.3898	556.4853	429.4096	268.5729	156.7235	102.1052	(83)
Total gains	681.6764	760.9499	878.7301	1012.0063	1067.4784	1107.4089	1051.0657	979.3511	871.2584	743.7141	668.9078	642.3352	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7955	34.0072	33.9381	34.0748	34.0748	34.1409	34.2056	34.2686	34.3302	34.1409	34.2686	34.1409	
alpha	3.2530	3.2671	3.2625	3.2717	3.2717	3.2761	3.2804	3.2846	3.2887	3.2761	3.2846	3.2761	
util living area													
	0.9610	0.9446	0.8982	0.7992	0.6563	0.4686	0.3482	0.3713	0.6115	0.8412	0.9366	0.9659	(86)
MIT	19.4501	19.6386	20.0355	20.4888	20.7980	20.9503	20.9859	20.9830	20.8809	20.4912	19.9236	19.4293	(87)
Th 2	19.9127	19.9187	19.9168	19.9207	19.9207	19.9225	19.9243	19.9261	19.9278	19.9225	19.9261	19.9225	(88)
util rest of house													
	0.9533	0.9340	0.8788	0.7627	0.5969	0.3890	0.2556	0.2734	0.5303	0.8018	0.9220	0.9590	(89)
MIT 2	17.8934	18.1658	18.7236	19.3399	19.7264	19.8883	19.9184	19.9189	19.8330	19.3635	18.5833	17.8705	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2834	18.5347	19.0522	19.6277	19.9948	20.1543	20.1858	20.1854	20.0955	19.6460	18.9190	18.2610	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1334	18.3847	18.9022	19.4777	19.8448	20.0043	20.0358	20.0354	19.9455	19.4960	18.7690	18.1110	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9360	0.9142	0.8565	0.7457	0.5924	0.3952	0.2654	0.2837	0.5318	0.7832	0.9016	0.9429	(94)
Useful gains	638.0463	695.6333	752.6702	754.6913	632.3879	437.6924	278.9374	277.7977	463.3058	582.5025	603.0783	605.6687	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1285.1572	1262.8104	1151.0229	961.0397	707.4408	452.2389	281.6912	281.1376	501.4819	778.2823	1040.9690	1260.3877	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	481.4505	381.1430	296.3744	148.5709	55.8394	0.0000	0.0000	0.0000	0.0000	145.6602	315.2813	487.1110	(98)

Space heating 2311.4306 (98)
Space heating per m2 (98) / (4) = 28.7778 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2554.0670 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	481.4505	381.1430	296.3744	148.5709	55.8394	0.0000	0.0000	0.0000	0.0000	145.6602	315.2813	487.1110	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	531.9895	421.1524	327.4855	164.1667	61.7010	0.0000	0.0000	0.0000	0.0000	160.9505	348.3772	538.2442	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7690	89.7890	89.7909	89.8163	89.6954	87.3000	87.3000	87.3000	87.3000	89.3191	89.6198	89.7743	(217)
Fuel for water heating, kWh/month	153.1877	116.9629	90.6462	43.3589	20.1706	0.0000	0.0000	18.0306	44.7335	92.0096	128.7554	153.5007	(219)

Water heating fuel used 861.3562 (219)
Annual totals kWh/year
Space heating fuel - main system 2554.0670 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 351.0461 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) = -1220.7247 -1220.7247 (233)
Total delivered energy for all uses 2670.7446 (238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2554.0670	9.7400	248.7661	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.3562	9.7400	83.8961	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			162.2482	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2554.0670	0.2160	551.6785	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.3562	0.2160	186.0529	(264)
Space and water heating			737.7314	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			351.2432	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2554.0670	1.2200	3115.9617	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.3562	1.2200	1050.8545	(264)
Space and water heating			4166.8162	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1880.6531	(272)
Primary energy kWh/m2/year			23.4145	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						706.6848

	Jun	Jul	Aug	
Solar gains	752	707	616	(P4)
Internal gains	430	412	420	
Total summer gains	1181	1118	1036	(P5)
Summer gain/loss ratio	3.55	3.36	3.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.52	22.23	21.89	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-346	**Issued on Date**	19/04/2023
Assessment Reference	As Built	**Prop Type Ref**	2-Opp-SEMI
Property	10, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	9.95	**TER**	18.65
Environmental	93 A	**% DER<TER**	46.65		
CO_2 Emissions (t/year)	0.51	**DFEE**	46.10	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.70		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.95 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.61 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 3.63 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6100	
Infiltration rate			0.3750	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4423	0.4336	0.4249	0.3816	0.3729	0.3295	0.3295	0.3209	0.3469	0.3729	0.3902	0.4076	(22b)
Effective ac	0.5978	0.5940	0.5903	0.5728	0.5695	0.5543	0.5543	0.5515	0.5602	0.5695	0.5761	0.5831	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9590	40.6989	40.4438	39.2459	39.0218	37.9784	37.9784	37.7852	38.3803	39.0218	39.4752	39.9492	(38)
Heat transfer coeff	99.4272	99.1670	98.9120	97.7140	97.4899	96.4466	96.4466	96.2534	96.8485	97.4899	97.9433	98.4173	(39)
Average = Sum(39)m / 12 =												97.7130	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2379	1.2346	1.2315	1.2166	1.2138	1.2008	1.2008	1.1984	1.2058	1.2138	1.2194	1.2253	(40)
HLP (average)												1.2165	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0095	33.0961	33.1815	33.5882	33.6655	34.0296	34.0296	34.0980	33.8884	33.6655	33.5096	33.3482	
alpha	3.2006	3.2064	3.2121	3.2392	3.2444	3.2686	3.2686	3.2732	3.2592	3.2444	3.2340	3.2232	
util living area													
	0.9844	0.9706	0.9399	0.8707	0.7546	0.5991	0.4600	0.5103	0.7352	0.9168	0.9742	0.9873	(86)
MIT	19.0317	19.3061	19.7355	20.2525	20.6509	20.8840	20.9633	20.9483	20.7644	20.2086	19.5208	18.9847	(87)
Th 2	19.8898	19.8924	19.8949	19.9068	19.9090	19.9194	19.9194	19.9213	19.9154	19.9090	19.9045	19.8998	(88)
util rest of house													
	0.9811	0.9645	0.9273	0.8437	0.7041	0.5191	0.3568	0.4047	0.6635	0.8933	0.9678	0.9846	(89)
MIT 2	17.2765	17.6747	18.2916	19.0208	19.5461	19.8269	19.9002	19.8919	19.7038	18.9802	17.9973	17.2143	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7162	18.0834	18.6533	19.3293	19.8229	20.0917	20.1665	20.1565	19.9695	19.2879	18.3790	17.6578	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5662	17.9334	18.5033	19.1793	19.6729	19.9417	20.0165	20.0065	19.8195	19.1379	18.2290	17.5078	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9493	0.9065	0.8221	0.6918	0.5209	0.3665	0.4136	0.6563	0.8717	0.9536	0.9757	(94)
Useful gains	490.9528	583.8259	664.1883	701.7867	643.4763	477.7102	320.9576	334.3505	473.4095	522.4355	481.6087	461.5170	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1319.0180	1292.4787	1187.2678	1004.4361	777.2731	515.1855	329.5073	347.1424	553.9214	832.3596	1090.0077	1309.7157	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	616.0805	476.2147	389.1712	217.9076	99.5448	0.0000	0.0000	0.0000	0.0000	230.5835	438.0473	631.0599	(98)
Space heating												3098.6094	(98)
Space heating per m2											(98) / (4) =	38.5783	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3423.8778	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	616.0805	476.2147	389.1712	217.9076	99.5448	0.0000	0.0000	0.0000	0.0000	230.5835	438.0473	631.0599	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	680.7519	526.2041	430.0234	240.7818	109.9942	0.0000	0.0000	0.0000	0.0000	254.7884	484.0302	697.3037	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8010	89.7295	89.5809	89.2585	88.6664	87.3000	87.3000	87.3000	87.3000	89.2732	89.6649	89.8296	(217)
Fuel for water heating, kWh/month													
	184.9785	162.3586	168.8790	149.2773	145.3226	129.0595	121.2740	136.7748	137.7020	154.9115	166.4125	179.5840	(219)
Water heating fuel used												1836.5342	(219)
Annual totals kWh/year													
Space heating fuel - main system												3423.8778	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =											-1074.8994	-1074.8994	(233)
Total delivered energy for all uses												4611.5587	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3423.8778	0.2160	739.5576	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.5342	0.2160	396.6914	(264)
Space and water heating			1136.2490	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			799.4941	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.9500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.9500	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		28.4083	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.4083	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9281	(36)
Total fabric heat loss	(33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.3750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4423	0.4336	0.4249	0.3816	0.3729	0.3295	0.3295	0.3209	0.3469	0.3729	0.3902	0.4076	(22b)
Effective ac	0.5978	0.5940	0.5903	0.5728	0.5695	0.5543	0.5543	0.5515	0.5602	0.5695	0.5761	0.5831	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9590	40.6989	40.4438	39.2459	39.0218	37.9784	37.9784	37.7852	38.3803	39.0218	39.4752	39.9492	(38)
Heat transfer coeff	99.4272	99.1670	98.9120	97.7140	97.4899	96.4466	96.4466	96.2534	96.8485	97.4899	97.9433	98.4173	(39)
Average = Sum(39)m / 12 =												97.7130	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2379	1.2346	1.2315	1.2166	1.2138	1.2008	1.2008	1.1984	1.2058	1.2138	1.2194	1.2253	(40)
HLP (average)												1.2165	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0095	33.0961	33.1815	33.5882	33.6655	34.0296	34.0296	34.0980	33.8884	33.6655	33.5096	33.3482	
alpha	3.2006	3.2064	3.2121	3.2392	3.2444	3.2686	3.2686	3.2732	3.2592	3.2444	3.2340	3.2232	
util living area													
	0.9871	0.9745	0.9457	0.8793	0.7656	0.6109	0.4705	0.5234	0.7496	0.9256	0.9782	0.9896	(86)
MIT	18.9799	19.2580	19.6948	20.2235	20.6341	20.8771	20.9608	20.9443	20.7494	20.1736	19.4736	18.9334	(87)
Th 2	19.8898	19.8924	19.8949	19.9068	19.9090	19.9194	19.9194	19.9213	19.9154	19.9090	19.9045	19.8998	(88)
util rest of house													
	0.9843	0.9691	0.9342	0.8535	0.7160	0.5305	0.3656	0.4162	0.6790	0.9039	0.9727	0.9873	(89)
MIT 2	18.0543	18.3312	18.7613	19.2758	19.6480	19.8520	19.9053	19.8995	19.7604	19.2428	18.5563	18.0155	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2862	18.5633	18.9951	19.5132	19.8950	20.1088	20.1697	20.1612	20.0081	19.4760	18.7861	18.2454	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2862	18.5633	18.9951	19.5132	19.8950	20.1088	20.1697	20.1612	20.0081	19.4760	18.7861	18.2454	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9225	0.8427	0.7153	0.5455	0.3909	0.4414	0.6858	0.8933	0.9652	0.9827	(94)
Useful gains	463.3302	560.4645	648.2227	695.9832	646.4676	487.0398	333.4863	345.8862	477.1151	510.4642	458.0850	433.7870	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1390.6064	1354.9507	1235.9160	1037.0588	798.9309	531.3063	344.2842	362.0317	572.1916	865.3193	1144.5711	1382.3130	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	689.8935	533.8948	437.2439	245.5744	113.4327	0.0000	0.0000	0.0000	0.0000	264.0121	494.2700	705.7034	(98)
Space heating												3484.0247	(98)
Space heating per m2											(98) / (4) =	43.3768	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	906.5978	713.7047	731.5256	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8436	0.8960	0.8712	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	764.8477	639.4876	637.2979	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	267.0062	333.3269	275.6745	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												876.0076	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.7516	83.3317	68.9186	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												219.0019	(107)
Space cooling per m2												2.7266	(108)
Energy for space heating												43.3768	(99)
Energy for space cooling												2.7266	(108)
Total												46.1034	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	44.2481	62.1032	49.3797	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												155.7311 (107)
Space cooling per m2												1.9389 (108)
Energy for space heating												45.0622 (99)
Energy for space cooling												1.9389 (108)
Total												47.0011 (109)
Target Fabric Energy Efficiency (TFEE)												54.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6100	
Infiltration rate			0.3750	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3642	0.3382	0.3469	0.3295	0.3295	0.3209	0.3122	0.3035	0.2948	0.3209	0.3035	0.3209	(22b)
Effective ac	0.5663	0.5572	0.5602	0.5543	0.5543	0.5515	0.5487	0.5461	0.5435	0.5515	0.5461	0.5515	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8028	38.1768	38.3803	37.9784	37.9784	37.7852	37.5972	37.4143	37.2365	37.7852	37.4143	37.7852	(38)
Heat transfer coeff	97.2709	96.6449	96.8485	96.4466	96.4466	96.2534	96.0653	95.8824	95.7046	96.2534	95.8824	96.2534	(39)
Average = Sum(39)m / 12 =												96.3294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2110	1.2032	1.2058	1.2008	1.2008	1.1984	1.1960	1.1938	1.1915	1.1984	1.1938	1.1984	(40)
HLP (average)												1.1993	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946 (83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7412	33.9598	33.8884	34.0296	34.0296	34.0980	34.1647	34.2299	34.2935	34.0980	34.2299	34.0980	
alpha	3.2494	3.2640	3.2592	3.2686	3.2686	3.2732	3.2776	3.2820	3.2862	3.2732	3.2820	3.2732	
util living area	0.9552	0.9354	0.8841	0.7834	0.6443	0.4601	0.3403	0.3581	0.5852	0.8184	0.9261	0.9611	(86)
MIT	19.5016	19.7028	20.0939	20.5210	20.8084	20.9527	20.9868	20.9847	20.8953	20.5375	19.9794	19.4750	(87)
Th 2	19.9112	19.9174	19.9154	19.9194	19.9194	19.9213	19.9232	19.9250	19.9268	19.9213	19.9250	19.9213	(88)
util rest of house	0.9465	0.9233	0.8628	0.7456	0.5848	0.3814	0.2495	0.2632	0.5049	0.7760	0.9097	0.9534	(89)
MIT 2	17.9654	18.2548	18.8013	19.3786	19.7360	19.8889	19.9176	19.9185	19.8446	19.4193	18.6594	17.9348	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3502	18.6175	19.1251	19.6648	20.0047	20.1554	20.1855	20.1856	20.1078	19.6994	18.9901	18.3206	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2002	18.4675	18.9751	19.5148	19.8547	20.0054	20.0355	20.0356	19.9578	19.5494	18.8401	18.1706	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9281	0.9025	0.8406	0.7297	0.5810	0.3878	0.2591	0.2732	0.5074	0.7590	0.8885	0.9363	(94)
Useful gains	667.7953	731.4654	784.6238	772.1342	638.1610	439.0956	279.4209	278.4746	469.7775	606.2660	633.4247	631.9259	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1293.7231	1272.5746	1159.7699	965.8922	709.3329	452.9101	281.9954	281.4726	503.1940	784.4094	1048.9599	1267.7153	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	465.6903	363.6254	279.1087	139.5057	52.9519	0.0000	0.0000	0.0000	0.0000	132.5387	299.1854	473.0273	(98)

Space heating 2205.6335 (98)
RHI space heating demand 2206 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6100	
Infiltration rate			0.3750	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4423	0.4336	0.4249	0.3816	0.3729	0.3295	0.3295	0.3209	0.3469	0.3729	0.3902	0.4076	(22b)
Effective ac	0.5978	0.5940	0.5903	0.5728	0.5695	0.5543	0.5543	0.5515	0.5602	0.5695	0.5761	0.5831	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9590	40.6989	40.4438	39.2459	39.0218	37.9784	37.9784	37.7852	38.3803	39.0218	39.4752	39.9492	(38)
Heat transfer coeff	99.4272	99.1670	98.9120	97.7140	97.4899	96.4466	96.4466	96.2534	96.8485	97.4899	97.9433	98.4173	(39)
Average = Sum(39)m / 12 =												97.7130	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2379	1.2346	1.2315	1.2166	1.2138	1.2008	1.2008	1.1984	1.2058	1.2138	1.2194	1.2253	(40)
HLP (average)												1.2165	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0095	33.0961	33.1815	33.5882	33.6655	34.0296	34.0296	34.0980	33.8884	33.6655	33.5096	33.3482	
alpha	3.2006	3.2064	3.2121	3.2392	3.2444	3.2686	3.2686	3.2732	3.2592	3.2444	3.2340	3.2232	
util living area													
	0.9645	0.9437	0.9024	0.8197	0.6950	0.5383	0.4056	0.4471	0.6588	0.8628	0.9457	0.9696	(86)
MIT	19.3083	19.5621	19.9489	20.3996	20.7304	20.9155	20.9746	20.9649	20.8322	20.3815	19.7647	19.2602	(87)
Th 2	19.8898	19.8924	19.8949	19.9068	19.9090	19.9194	19.9194	19.9213	19.9154	19.9090	19.9045	19.8998	(88)
util rest of house													
	0.9577	0.9331	0.8841	0.7867	0.6414	0.4615	0.3120	0.3507	0.5842	0.8296	0.9336	0.9637	(89)
MIT 2	17.6742	18.0381	18.5859	19.2107	19.6357	19.8538	19.9065	19.9020	19.7708	19.2060	18.3424	17.6114	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0835	18.4199	18.9273	19.5085	19.9099	20.1198	20.1740	20.1683	20.0367	19.5005	18.6987	18.0244	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9335	18.2699	18.7773	19.3585	19.7599	19.9698	20.0240	20.0183	19.8867	19.3505	18.5487	17.8744	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9409	0.9127	0.8613	0.7677	0.6334	0.4653	0.3213	0.3597	0.5820	0.8090	0.9136	0.9483	(94)
Useful gains	645.0257	723.4366	777.3204	777.1489	682.1822	490.8274	324.4281	339.7612	503.5336	610.3439	613.8482	615.3631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1355.5425	1325.8523	1214.3751	1021.9414	785.7596	517.8943	330.2365	348.2728	560.4315	853.0814	1121.3258	1345.7985	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	528.6245	404.8233	325.1687	176.2506	77.0616	0.0000	0.0000	0.0000	0.0000	180.5967	365.3839	543.4440	(98)
Space heating												2601.3533	(98)
Space heating per m2											(98) / (4) =	32.3874	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2874.4235	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	528.6245	404.8233	325.1687	176.2506	77.0616	0.0000	0.0000	0.0000	0.0000	180.5967	365.3839	543.4440	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	584.1155	447.3186	359.3024	194.7520	85.1509	0.0000	0.0000	0.0000	0.0000	199.5544	403.7391	600.4906	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7137	89.6306	89.4588	89.0940	88.4707	87.3000	87.3000	87.3000	87.3000	89.0839	89.5482	89.7470	(217)
Fuel for water heating, kWh/month													
	185.1583	162.5378	169.1094	149.5530	145.6441	129.0595	121.2740	136.7748	137.7020	155.2406	166.6293	179.7493	(219)
Water heating fuel used												1838.4322	(219)
Annual totals kWh/year													
Space heating fuel - main system												2874.4235	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4064.0024	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2874.4235	3.4800	100.0299	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.4322	3.4800	63.9774	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			198.4236	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6650	(257)
SAP value		90.7232	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2874.4235	0.2160	620.8755	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.4322	0.2160	397.1013	(264)
Space and water heating			1017.9768	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			681.2220	(272)
CO2 emissions per m2			8.4800	(273)
EI value			92.7159	
EI rating			93	(274)
EI band			A	

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Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8866 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.3750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3642	0.3382	0.3469	0.3295	0.3295	0.3209	0.3122	0.3035	0.2948	0.3209	0.3035	0.3209	(22b)
Effective ac	0.5663	0.5572	0.5602	0.5543	0.5543	0.5515	0.5487	0.5461	0.5435	0.5515	0.5461	0.5515	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7399	(36)
Total fabric heat loss	(33) + (36) = 58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8028	38.1768	38.3803	37.9784	37.9784	37.7852	37.5972	37.4143	37.2365	37.7852	37.4143	37.7852	(38)
Heat transfer coeff	97.2709	96.6449	96.8485	96.4466	96.4466	96.2534	96.0653	95.8824	95.7046	96.2534	95.8824	96.2534	(39)
Average = Sum(39)m / 12 =												96.3294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2110	1.2032	1.2058	1.2008	1.2008	1.1984	1.1960	1.1938	1.1915	1.1984	1.1938	1.1984	(40)
HLP (average)												1.1993	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946	(83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7412	33.9598	33.8884	34.0296	34.0296	34.0980	34.1647	34.2299	34.2935	34.0980	34.2299	34.0980	
alpha	3.2494	3.2640	3.2592	3.2686	3.2686	3.2732	3.2776	3.2820	3.2862	3.2732	3.2820	3.2732	
util living area													
	0.9552	0.9354	0.8841	0.7834	0.6443	0.4601	0.3403	0.3581	0.5852	0.8184	0.9261	0.9611	(86)
MIT	19.5016	19.7028	20.0939	20.5210	20.8084	20.9527	20.9868	20.9847	20.8953	20.5375	19.9794	19.4750	(87)
Th 2	19.9112	19.9174	19.9154	19.9194	19.9194	19.9213	19.9232	19.9250	19.9268	19.9213	19.9250	19.9213	(88)
util rest of house													
	0.9465	0.9233	0.8628	0.7456	0.5848	0.3814	0.2495	0.2632	0.5049	0.7760	0.9097	0.9534	(89)
MIT 2	17.9654	18.2548	18.8013	19.3786	19.7360	19.8889	19.9176	19.9185	19.8446	19.4193	18.6594	17.9348	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3502	18.6175	19.1251	19.6648	20.0047	20.1554	20.1855	20.1856	20.1078	19.6994	18.9901	18.3206	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2002	18.4675	18.9751	19.5148	19.8547	20.0054	20.0355	20.0356	19.9578	19.5494	18.8401	18.1706	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9281	0.9025	0.8406	0.7297	0.5810	0.3878	0.2591	0.2732	0.5074	0.7590	0.8885	0.9363	(94)
Useful gains	667.7953	731.4654	784.6238	772.1342	638.1610	439.0956	279.4209	278.4746	469.7775	606.2660	633.4247	631.9259	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1293.7231	1272.5746	1159.7699	965.8922	709.3329	452.9101	281.9954	281.4726	503.1940	784.4094	1048.9599	1267.7153	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.6903	363.6254	279.1087	139.5057	52.9519	0.0000	0.0000	0.0000	0.0000	132.5387	299.1854	473.0273	(98)
Space heating												2205.6335	(98)
Space heating per m2											(98) / (4) =	27.4606	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2437.1640	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	465.6903	363.6254	279.1087	139.5057	52.9519	0.0000	0.0000	0.0000	0.0000	132.5387	299.1854	473.0273	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	514.5749	401.7961	308.4074	154.1500	58.5104	0.0000	0.0000	0.0000	0.0000	146.4516	330.5916	522.6821	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6361	89.5610	89.3488	88.9079	88.2084	87.3000	87.3000	87.3000	87.3000	88.8372	89.4094	89.6642	(217)
Fuel for water heating, kWh/month													
	185.3186	162.6641	169.3176	149.8660	146.0771	129.0595	121.2740	136.7748	137.7020	155.6717	166.8881	179.9154	(219)
Water heating fuel used												1840.5288	(219)
Annual totals kWh/year													
Space heating fuel - main system												2437.1640	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3483.0143	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2437.1640	9.7400	237.3798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.5288	9.7400	179.2675	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			227.8082	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2437.1640	0.2160	526.4274	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.5288	0.2160	397.5542	(264)
Space and water heating			923.9817	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			511.5435	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2437.1640	1.2200	2973.3401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.5288	1.2200	2245.4451	(264)
Space and water heating			5218.7853	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2779.1222	(272)
Primary energy kWh/m2/year			34.6006	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (36.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 92	A 95
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£157	£175	-£18
Mains gas	£521	£425	£95
Space heating	£369	£369	£0
Water heating	£179	£102	£77
Lighting	£129	£129	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£228	£150	£77
Total cost of uses	£227	£150	£77
Delivered energy	43 kWh/m²	32 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	35 kWh/m²	22 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.6100	
Infiltration rate				0.3750	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4423	0.4336	0.4249	0.3816	0.3729	0.3295	0.3295	0.3209	0.3469	0.3729	0.3902	0.4076	(22b)
Effective ac	0.5978	0.5940	0.5903	0.5728	0.5695	0.5543	0.5543	0.5515	0.5602	0.5695	0.5761	0.5831	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9590	40.6989	40.4438	39.2459	39.0218	37.9784	37.9784	37.7852	38.3803	39.0218	39.4752	39.9492	(38)
Heat transfer coeff	99.4272	99.1670	98.9120	97.7140	97.4899	96.4466	96.4466	96.2534	96.8485	97.4899	97.9433	98.4173	(39)
Average = Sum(39)m / 12 =												97.7130	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2379	1.2346	1.2315	1.2166	1.2138	1.2008	1.2008	1.1984	1.2058	1.2138	1.2194	1.2253	(40)
HLP (average)												1.2165	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                                  Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
             166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (62)
Aperture area of solar collector                                                                                                     3.0000 (H1)
Zero-loss collector efficiency                                                                                                       0.7000 (H2)
Collector heat loss coefficient                                                                                                      1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                            0.0050 (H3a)
Collector effective heat loss coefficient                                                                                            1.8063 (H3b)
Collector performance ratio                                                                                                          2.5804 (H4)
Annual solar radiation per m2                                                                                                     1079.5246 (H5)
Overshading factor                                                                                                                   0.8000 (H6)
Solar energy available                                                                                                            1813.6014 (H7)
Adjustment factor for showers                                                                                                        1.0000 (H7a)
Solar-to-load ratio                                                                                                                  1.2416 (H8)
Utilisation factor                                                                                                                   0.5531 (H9)
Collector performance factor                                                                                                         0.8793 (H10)
Dedicated solar storage volume                                                                                                      75.0000 (H11)
Effective solar volume                                                                                                              75.0000 (H13)
Daily hot water demand                                                                                                              92.8365 (H14)
Volume ratio Veff/V                                                                                                                  0.8079 (H15)
Solar storage volume factor                                                                                                          0.9573 (H16)
Solar input                                                                                                                       -844.3736 (H17)
Solar input    -24.4852   -40.8587   -69.5870   -93.2603  -115.2152  -113.2749  -111.7780   -97.6610   -76.4881   -52.2324   -29.0429   -20.4899 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -844.3736 (63)
Output from w/h
             141.6273   104.8249    81.6962    39.9825    13.6371     0.0000     0.0000    21.7434    43.7257    86.0620   120.1707   140.8297 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    794.2995 (64)
Heat gains from water heating, kWh/month
              54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              49.6942    44.1380    35.8954    27.1751    20.3137    17.1497    18.5309    24.0871    32.3297    41.0499    47.9113    51.0754 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
              72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
             555.4843   551.1854   529.8840   496.8036   462.9135   432.5030   414.6759   422.8658   441.8488   475.1411   512.1843   540.2300 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
East                                    3.6300           19.6403            0.4600           0.0000           0.7700           25.2524 (76)
South                                   2.4700           46.7521            0.4600           0.0000           0.7700           40.9022 (78)
West                                    4.6800           19.6403            0.4600           0.0000           0.7700           32.5568 (80)
West                                    4.5100           19.6403            0.4600           0.0000           0.7700           31.3742 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains    130.0855   241.4488   372.6432   515.4707   614.0341   622.4112   594.9807   521.6777   423.2944   279.2654   159.6842   108.6833 (83)
Total gains    685.5699   792.6342   902.5272  1012.2743  1076.9476  1054.9142  1009.6566   944.5435   865.1432   754.4065   671.8685   648.9133 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                         21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          33.0095    33.0961    33.1815    33.5882    33.6655    34.0296    34.0296    34.0980    33.8884    33.6655    33.5096    33.3482
alpha         3.2006     3.2064     3.2121     3.2392     3.2444     3.2686     3.2686     3.2732     3.2592     3.2444     3.2340     3.2232
util living area
               0.9645     0.9437     0.9024     0.8197     0.6950     0.5383     0.4056     0.4471     0.6588     0.8628     0.9457     0.9696 (86)

MIT           19.3083    19.5621    19.9489    20.3996    20.7304    20.9155    20.9746    20.9649    20.8322    20.3815    19.7647    19.2602 (87)
Th 2          19.8898    19.8924    19.8949    19.9068    19.9090    19.9194    19.9194    19.9213    19.9154    19.9090    19.9045    19.8998 (88)
util rest of house
               0.9577     0.9331     0.8841     0.7867     0.6414     0.4615     0.3120     0.3507     0.5842     0.8296     0.9336     0.9637 (89)
MIT 2         17.6742    18.0381    18.5859    19.2107    19.6357    19.8538    19.9065    19.9020    19.7708    19.2060    18.3424    17.6114 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2505 (91)
MIT           18.0835    18.4199    18.9273    19.5085    19.9099    20.1198    20.1740    20.1683    20.0367    19.5005    18.6987    18.0244 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.9335    18.2699    18.7773    19.3585    19.7599    19.9698    20.0240    20.0183    19.8867    19.3505    18.5487    17.8744 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9409	0.9127	0.8613	0.7677	0.6334	0.4653	0.3213	0.3597	0.5820	0.8090	0.9136	0.9483	(94)
Useful gains	645.0257	723.4366	777.3204	777.1489	682.1822	490.8274	324.4281	339.7612	503.5336	610.3439	613.8482	615.3631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1355.5425	1325.8523	1214.3751	1021.9414	785.7596	517.8943	330.2365	348.2728	560.4315	853.0814	1121.3258	1345.7985	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	528.6245	404.8233	325.1687	176.2506	77.0616	0.0000	0.0000	0.0000	0.0000	180.5967	365.3839	543.4440	(98)
Space heating												2601.3533	(98)
Space heating per m2											(98) / (4) =	32.3874	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2874.4235	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	528.6245	404.8233	325.1687	176.2506	77.0616	0.0000	0.0000	0.0000	0.0000	180.5967	365.3839	543.4440	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	584.1155	447.3186	359.3024	194.7520	85.1509	0.0000	0.0000	0.0000	0.0000	199.5544	403.7391	600.4906	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8044	89.8228	89.8388	89.8907	90.0040	87.3000	87.3000	87.3000	87.3000	89.4419	89.6864	89.8224	(217)
Fuel for water heating, kWh/month	157.7064	116.7019	90.9365	44.4789	15.1517	0.0000	0.0000	24.9065	50.0868	96.2211	133.9899	156.7869	(219)
Water heating fuel used												886.9666	(219)
Annual totals kWh/year													
Space heating fuel - main system												2874.4235	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3162.5368	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2874.4235	3.4800	100.0299	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9666	3.4800	30.8664	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			171.9076	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5761	(257)
SAP value	91.9629	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2874.4235	0.2160	620.8755	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9666	0.2160	191.5848	(264)
Space and water heating			812.4603	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			501.6554	(272)
CO2 emissions per m2			6.2500	(273)
EI value			94.6360	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.6100	
Infiltration rate			0.3750	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3469	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3642	0.3382	0.3469	0.3295	0.3295	0.3209	0.3122	0.3035	0.2948	0.3209	0.3035	0.3209	(22b)
Effective ac	0.5663	0.5572	0.5602	0.5543	0.5543	0.5515	0.5487	0.5461	0.5435	0.5515	0.5461	0.5515	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.8028	38.1768	38.3803	37.9784	37.9784	37.7852	37.5972	37.4143	37.2365	37.7852	37.4143	37.7852	(38)
Heat transfer coeff	97.2709	96.6449	96.8485	96.4466	96.4466	96.2534	96.0653	95.8824	95.7046	96.2534	95.8824	96.2534	(39)
Average = Sum(39)m / 12 =												96.3294	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2110	1.2032	1.2058	1.2008	1.2008	1.1984	1.1960	1.1938	1.1915	1.1984	1.1938	1.1984	(40)
HLP (average)												1.1993	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3896 (H8)
Utilisation factor	0.5131 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-876.6189 (H17)

Solar input

-28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154 (63)

Solar input (sum of months) = Sum(63)m = -876.6189 (63)

Output from w/h

137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042 (64)

Total per year (kWh/year) = Sum(64)m = 771.1322 (64)

Heat gains from water heating, kWh/month

54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946 (83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246 (84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7412	33.9598	33.8884	34.0296	34.0296	34.0980	34.1647	34.2299	34.2935	34.0980	34.2299	34.0980	
alpha	3.2494	3.2640	3.2592	3.2686	3.2686	3.2732	3.2776	3.2820	3.2862	3.2732	3.2820	3.2732	
util living area	0.9552	0.9354	0.8841	0.7834	0.6443	0.4601	0.3403	0.3581	0.5852	0.8184	0.9261	0.9611	(86)
MIT	19.5016	19.7028	20.0939	20.5210	20.8084	20.9527	20.9868	20.9847	20.8953	20.5375	19.9794	19.4750	(87)
Th 2	19.9112	19.9174	19.9154	19.9194	19.9194	19.9213	19.9232	19.9250	19.9268	19.9213	19.9250	19.9213	(88)
util rest of house	0.9465	0.9233	0.8628	0.7456	0.5848	0.3814	0.2495	0.2632	0.5049	0.7760	0.9097	0.9534	(89)
MIT 2	17.9654	18.2548	18.8013	19.3786	19.7360	19.8889	19.9176	19.9185	19.8446	19.4193	18.6594	17.9348	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3502	18.6175	19.1251	19.6648	20.0047	20.1554	20.1855	20.1856	20.1078	19.6994	18.9901	18.3206	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2002	18.4675	18.9751	19.5148	19.8547	20.0054	20.0355	20.0356	19.9578	19.5494	18.8401	18.1706	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9281	0.9025	0.8406	0.7297	0.5810	0.3878	0.2591	0.2732	0.5074	0.7590	0.8885	0.9363	(94)
Useful gains	667.7953	731.4654	784.6238	772.1342	638.1610	439.0956	279.4209	278.4746	469.7775	606.2660	633.4247	631.9259	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1293.7231	1272.5746	1159.7699	965.8922	709.3329	452.9101	281.9954	281.4726	503.1940	784.4094	1048.9599	1267.7153	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	465.6903	363.6254	279.1087	139.5057	52.9519	0.0000	0.0000	0.0000	0.0000	132.5387	299.1854	473.0273	(98)
Space heating												2205.6335	(98)
Space heating per m2											(98) / (4) =	27.4606	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2437.1640	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	465.6903	363.6254	279.1087	139.5057	52.9519	0.0000	0.0000	0.0000	0.0000	132.5387	299.1854	473.0273	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	514.5749	401.7961	308.4074	154.1500	58.5104	0.0000	0.0000	0.0000	0.0000	146.4516	330.5916	522.6821	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7500	89.7627	89.7572	89.7818	89.6630	87.3000	87.3000	87.3000	87.3000	89.2479	89.5860	89.7578	(217)
Fuel for water heating, kWh/month	153.2201	116.9972	90.6803	43.3756	20.1779	0.0000	0.0000	18.0306	44.7335	92.0830	128.8040	153.5290	(219)
Water heating fuel used												861.6312	(219)

Annual totals kWh/year		
Space heating fuel - main system	2437.1640	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =	-1220.7247	(233)
Total delivered energy for all uses	2554.1167	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2437.1640	9.7400	237.3798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.6312	9.7400	83.9229	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			150.8886	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2437.1640	0.2160	526.4274	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6312	0.2160	186.1123	(264)
Space and water heating			712.5398	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			326.0516	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2437.1640	1.2200	2973.3401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6312	1.2200	1051.1900	(264)
Space and water heating			4024.5301	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1738.3671	(272)
Primary energy kWh/m2/year			21.6430	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-347	**Issued on Date**	19/04/2023
Assessment Reference	As Built	**Prop Type Ref**	2-As-SEMI
Property	9, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.29	**TER**	18.91
Environmental	93 A	**% DER<TER**	45.59		
CO_2 Emissions (t/year)	0.53	**DFEE**	47.06	**TFEE**	54.92
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.31		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.29 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.1 kWh/m²/yrOK
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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.71 (measured in this dwelling)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.82 m², No overhang
Windows facing East: 3.63 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.7100	
Infiltration rate				0.3800	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4482	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4130	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124	(36)
Total fabric heat loss	(33) + (36) =	56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1389	40.8717	40.6099	39.3798	39.1497	38.0783	38.0783	37.8799	38.4910	39.1497	39.6152	40.1020	(38)
Heat transfer coeff	97.6531	97.3859	97.1240	95.8940	95.6638	94.5925	94.5925	94.3941	95.0051	95.6638	96.1294	96.6161	(39)
Average = Sum(39)m / 12 =												95.8929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2158	1.2125	1.2092	1.1939	1.1910	1.1777	1.1777	1.1752	1.1828	1.1910	1.1968	1.2029	(40)
HLP (average)												1.1939	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.9940	373.8631	360.2816	338.4046	316.1994	294.8241	280.9619	286.9838	298.2468	320.3358	345.6941	364.7045	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	468.2658	554.2268	657.6241	773.5434	851.4364	843.7512	803.1352	734.0997	644.4624	534.3748	460.7052	440.6192	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8547	33.9476	34.0391	34.4757	34.5587	34.9501	34.9501	35.0235	34.7983	34.5587	34.3913	34.2180	
alpha	3.2570	3.2632	3.2693	3.2984	3.3039	3.3300	3.3300	3.3349	3.3199	3.3039	3.2928	3.2812	
util living area													
	0.9877	0.9780	0.9540	0.8939	0.7842	0.6295	0.4885	0.5448	0.7750	0.9362	0.9801	0.9899	(86)
MIT	19.0202	19.2601	19.6744	20.2009	20.6214	20.8729	20.9592	20.9412	20.7332	20.1563	19.4934	18.9817	(87)
Th 2	19.9074	19.9100	19.9126	19.9249	19.9272	19.9379	19.9379	19.9399	19.9338	19.9272	19.9225	19.9177	(88)
util rest of house													
	0.9851	0.9734	0.9440	0.8704	0.7366	0.5497	0.3823	0.4366	0.7076	0.9172	0.9751	0.9877	(89)
MIT 2	17.2695	17.6189	18.2172	18.9665	19.5278	19.8348	19.9161	19.9057	19.6878	18.9224	17.9684	17.2196	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7080	18.0300	18.5822	19.2757	19.8017	20.0948	20.1774	20.1651	19.9497	19.2315	18.3504	17.6610	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5580	17.8800	18.4322	19.1257	19.6517	19.9448	20.0274	20.0151	19.7997	19.0815	18.2004	17.5110	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9764	0.9607	0.9255	0.8489	0.7227	0.5502	0.3917	0.4448	0.6977	0.8970	0.9632	0.9802	(94)
Useful gains	457.2308	532.4644	608.6431	656.6783	615.3228	464.2651	314.5856	326.5167	449.6663	479.3519	443.7687	431.9109	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1294.6869	1264.0695	1158.9065	980.5836	760.6933	505.5785	324.2017	341.2404	541.4990	811.3751	1067.0771	1286.0546	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	623.0673	491.6386	409.3960	233.2119	108.1557	0.0000	0.0000	0.0000	0.0000	247.0253	448.7820	635.4829	(98)
Space heating												3196.7597	(98)
Space heating per m2											(98) / (4) =	39.8003	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3532.3311	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	623.0673	491.6386	409.3960	233.2119	108.1557	0.0000	0.0000	0.0000	0.0000	247.0253	448.7820	635.4829	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	688.4722	543.2471	452.3713	257.6927	119.5090	0.0000	0.0000	0.0000	0.0000	272.9561	495.8918	702.1911	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8071	89.7480	89.6137	89.3097	88.7317	87.3000	87.3000	87.3000	87.3000	89.3249	89.6798	89.8333	(217)
Fuel for water heating, kWh/month													
	184.9658	162.3251	168.8171	149.1918	145.2156	129.0595	121.2740	136.7748	137.7020	154.8218	166.3849	179.5766	(219)
Water heating fuel used												1836.1091	(219)
Annual totals kWh/year													
Space heating fuel - main system												3532.3311	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4726.0236	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3532.3311	0.2160	762.9835	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.1091	0.2160	396.5996	(264)
Space and water heating			1159.5831	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			826.1688	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.2900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.2900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		28.7483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.6400	1.3258	18.0833			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.1800	13.8474			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5023			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.5511	(36)
Total fabric heat loss (33) + (36) =	54.0534	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	95.7275	95.4395	95.1573	93.8315	93.5835	92.4288	92.4288	92.2150	92.8736	93.5835	94.0853	94.6099	(39)
Average = Sum(39)m / 12 =												93.8303	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1918	1.1882	1.1847	1.1682	1.1651	1.1508	1.1508	1.1481	1.1563	1.1651	1.1714	1.1779	(40)
HLP (average)												1.1682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	388.1874	385.7909	371.5886	349.0932	326.2645	304.2681	290.4147	297.0571	308.9477	331.6551	357.6289	376.9027	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.6300	0.7000	0.7700	2.6648	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	79.6145	155.6225	256.5549	375.4491	461.8165	473.6286	450.5447	385.7833	298.7239	184.6785	99.2346	65.5012	(83)
Total gains	467.8019	541.4134	628.1434	724.5423	788.0810	777.8967	740.9594	682.8405	607.6716	516.3335	456.8635	442.4039	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2673	58.4431	58.6164	59.4446	59.6022	60.3467	60.3467	60.4867	60.0577	59.6022	59.2843	58.9556	
alpha	4.8845	4.8962	4.9078	4.9630	4.9735	5.0231	5.0231	5.0324	5.0038	4.9735	4.9523	4.9304	
util living area													
	0.9982	0.9961	0.9884	0.9582	0.8711	0.7035	0.5364	0.5985	0.8548	0.9795	0.9964	0.9987	(86)
MIT	19.6868	19.8420	20.1182	20.4859	20.7856	20.9482	20.9892	20.9819	20.8582	20.4548	20.0070	19.6649	(87)
Th 2	19.9265	19.9294	19.9322	19.9455	19.9480	19.9596	19.9596	19.9617	19.9551	19.9480	19.9430	19.9377	(88)
util rest of house													
	0.9976	0.9947	0.9842	0.9423	0.8238	0.6112	0.4160	0.4746	0.7840	0.9689	0.9950	0.9982	(89)
MIT 2	18.1773	18.4058	18.8091	19.3418	19.7386	19.9254	19.9557	19.9543	19.8399	19.3083	18.6571	18.1532	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5554	18.7656	19.1370	19.6284	20.0008	20.1816	20.2146	20.2117	20.0950	19.5955	18.9952	18.5319	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5554	18.7656	19.1370	19.6284	20.0008	20.1816	20.2146	20.2117	20.0950	19.5955	18.9952	18.5319	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9925	0.9798	0.9362	0.8265	0.6322	0.4463	0.5058	0.7950	0.9641	0.9930	0.9973	(94)
Useful gains	466.1519	537.3689	615.4815	678.3389	651.3852	491.7871	330.7047	345.3521	483.0919	497.7775	453.6493	441.2109	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1364.6363	1323.3232	1202.5065	1006.6588	776.8213	515.9017	334.0889	351.4970	556.7733	841.8327	1119.1658	1355.9348	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.4724	528.1613	436.7465	236.3903	93.3245	0.0000	0.0000	0.0000	0.0000	255.9771	479.1719	680.5545	(98)
Space heating												3378.7985	(98)
Space heating per m2											(98) / (4) =	42.0667	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3617.5573	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.4724	528.1613	436.7465	236.3903	93.3245	0.0000	0.0000	0.0000	0.0000	255.9771	479.1719	680.5545	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.7092	565.4832	467.6087	253.0946	99.9191	0.0000	0.0000	0.0000	0.0000	274.0654	513.0320	728.6451	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8325	87.6249	87.1396	85.9705	83.7640	80.3000	80.3000	80.3000	80.3000	86.0505	87.3564	87.9117	(217)
Fuel for water heating, kWh/month													
	230.4389	202.8482	212.2257	190.7933	189.5874	174.1812	166.8789	186.0308	188.0853	199.8601	210.1573	224.7956	(219)
Water heating fuel used												2375.8828	(219)
Annual totals kWh/year													
Space heating fuel - main system												3617.5573	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Total delivered energy for all uses												6425.9228	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3617.5573	0.2160	781.3924	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2375.8828	0.2160	513.1907	(264)
Space and water heating			1294.5831	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Total CO2, kg/m2/year			1519.0416	(272)
Emissions per m2 for space and water heating			16.1178	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3099	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1178 * 1.00) + 2.3099 + 0.4846, rounded to 2 d.p.			18.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3800	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4482	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4130	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.4124	(36)
Total fabric heat loss	(33) + (36) = 56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1389	40.8717	40.6099	39.3798	39.1497	38.0783	38.0783	37.8799	38.4910	39.1497	39.6152	40.1020	(38)
Heat transfer coeff	97.6531	97.3859	97.1240	95.8940	95.6638	94.5925	94.5925	94.3941	95.0051	95.6638	96.1294	96.6161	(39)
Average = Sum(39)m / 12 =												95.8929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2158	1.2125	1.2092	1.1939	1.1910	1.1777	1.1777	1.1752	1.1828	1.1910	1.1968	1.2029	(40)
HLP (average)												1.1939	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.6381	342.2884	330.3291	310.6547	289.8803	270.5172	258.3616	262.1929	272.6747	292.4847	315.2690	333.1242	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	435.9099	522.6521	627.6716	745.7934	825.1174	819.4443	780.5348	709.3088	618.8903	506.5237	430.2802	409.0389	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8547	33.9476	34.0391	34.4757	34.5587	34.9501	34.9501	35.0235	34.7983	34.5587	34.3913	34.2180	
alpha	3.2570	3.2632	3.2693	3.2984	3.3039	3.3300	3.3300	3.3349	3.3199	3.3039	3.2928	3.2812	
util living area													
	0.9900	0.9813	0.9592	0.9022	0.7957	0.6424	0.5004	0.5597	0.7901	0.9442	0.9836	0.9919	(86)
MIT	18.9678	19.2106	19.6314	20.1692	20.6023	20.8648	20.9561	20.9363	20.7153	20.1187	19.4451	18.9299	(87)
Th 2	19.9074	19.9100	19.9126	19.9249	19.9272	19.9379	19.9379	19.9399	19.9338	19.9272	19.9225	19.9177	(88)
util rest of house													
	0.9878	0.9773	0.9502	0.8801	0.7492	0.5624	0.3924	0.4500	0.7245	0.9270	0.9794	0.9901	(89)
MIT 2	18.0544	18.2971	18.7137	19.2416	19.6391	19.8625	19.9218	19.9143	19.7528	19.2062	18.5410	18.0242	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2832	18.5260	18.9436	19.4740	19.8804	20.1135	20.1809	20.1703	19.9939	19.4348	18.7675	18.2510	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2832	18.5260	18.9436	19.4740	19.8804	20.1135	20.1809	20.1703	19.9939	19.4348	18.7675	18.2510	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9705	0.9399	0.8690	0.7469	0.5766	0.4183	0.4754	0.7287	0.9170	0.9733	0.9863	(94)
Useful gains	428.6546	507.2139	589.9447	648.0929	616.3097	472.4966	326.4983	337.1724	450.9729	464.4882	418.7801	403.4267	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1365.4986	1326.9757	1208.5703	1013.9794	782.5702	521.5397	338.7236	355.8936	559.9487	845.1660	1121.5868	1357.5571	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	697.0119	550.8799	460.2574	263.4382	123.6979	0.0000	0.0000	0.0000	0.0000	283.2243	506.0209	709.8730	(98)
Space heating												3594.4034	(98)
Space heating per m2											(98) / (4) =	44.7510	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	889.1692	699.9843	717.3949	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8285	0.8844	0.8548	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	736.6420	619.0669	613.1987	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1050.1136	1002.7477	921.1196	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	225.6995	285.4585	229.0932	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												740.2512	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	56.4249	71.3646	57.2733	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												185.0628	(107)
Space cooling per m2												2.3041	(108)
Energy for space heating												44.7510	(99)
Energy for space cooling												2.3041	(108)
Total												47.0551	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.6400	1.3258	18.0833			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.1800	13.8474			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5023			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.5511	(36)
Total fabric heat loss					(33) + (36) =		54.0534	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	95.7275	95.4395	95.1573	93.8315	93.5835	92.4288	92.4288	92.2150	92.8736	93.5835	94.0853	94.6099	(39)
Average = Sum(39)m / 12 =												93.8303	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1918	1.1882	1.1847	1.1682	1.1651	1.1508	1.1508	1.1481	1.1563	1.1651	1.1714	1.1779	(40)
HLP (average)												1.1682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4689	(42)
Average daily hot water use (litres/day)												92.8365	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.6381	342.2884	330.3291	310.6547	289.8803	270.5172	258.3616	262.1929	272.6747	292.4847	315.2690	333.1242	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.6300	0.7000	0.7700	2.6648	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	79.6145	155.6225	256.5549	375.4491	461.8165	473.6286	450.5447	385.7833	298.7239	184.6785	99.2346	65.5012	(83)
Total gains	423.2526	497.9109	586.8840	686.1038	751.6968	744.1458	708.9063	647.9762	571.3985	477.1632	414.5036	398.6254	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2673	58.4431	58.6164	59.4446	59.6022	60.3467	60.3467	60.4867	60.0577	59.6022	59.2843	58.9556	
alpha	4.8845	4.8962	4.9078	4.9630	4.9735	5.0231	5.0231	5.0324	5.0038	4.9735	4.9523	4.9304	
util living area													
	0.9989	0.9973	0.9913	0.9658	0.8872	0.7262	0.5581	0.6256	0.8774	0.9851	0.9977	0.9992	(86)
MIT	19.6355	19.7923	20.0728	20.4491	20.7628	20.9402	20.9871	20.9780	20.8371	20.4132	19.9584	19.6143	(87)
Th 2	19.9265	19.9294	19.9322	19.9455	19.9480	19.9596	19.9596	19.9617	19.9551	19.9480	19.9430	19.9377	(88)
util rest of house													
	0.9985	0.9963	0.9880	0.9523	0.8434	0.6342	0.4341	0.4986	0.8121	0.9771	0.9967	0.9989	(89)
MIT 2	18.6811	18.8399	19.1208	19.4991	19.7872	19.9322	19.9563	19.9554	19.8620	19.4716	19.0168	18.6688	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9202	19.0785	19.3593	19.7371	20.0316	20.1847	20.2146	20.2116	20.1063	19.7074	19.2527	18.9056	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9202	19.0785	19.3593	19.7371	20.0316	20.1847	20.2146	20.2116	20.1063	19.7074	19.2527	18.9056	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9857	0.9490	0.8474	0.6556	0.4655	0.5307	0.8233	0.9746	0.9958	0.9985	(94)
Useful gains	422.3944	495.5496	578.4803	651.0838	637.0207	487.8768	330.0092	343.8913	470.4103	465.0543	412.7629	398.0259	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1399.5508	1353.1845	1223.6557	1016.8592	779.7014	516.1846	334.0887	351.4852	557.8223	852.3059	1143.3863	1391.2962	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0044	576.3306	480.0105	263.3582	106.1544	0.0000	0.0000	0.0000	0.0000	288.1152	526.0489	738.9931	(98)
Space heating												3706.0153	(98)
Space heating per m2											(98) / (4) =	46.1406	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	868.8309	683.9733	700.8339	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8734	0.9302	0.9032	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	758.8619	636.2480	632.9809	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	962.1024	919.0260	849.4321	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.3332	210.3868	161.0397	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												517.7597	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	36.5833	52.5967	40.2599	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												129.4399 (107)
Space cooling per m2												1.6116 (108)
Energy for space heating												46.1406 (99)
Energy for space cooling												1.6116 (108)
Total												47.7522 (109)
Target Fabric Energy Efficiency (TFEE)												54.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.3800	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3691	0.3427	0.3515	0.3339	0.3339	0.3251	0.3163	0.3076	0.2988	0.3251	0.3076	0.3251	(22b)
Effective ac	0.5681	0.5587	0.5618	0.5557	0.5557	0.5529	0.5500	0.5473	0.5446	0.5529	0.5473	0.5529	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124 (36)
Total fabric heat loss	(33) + (36) =	56.5142 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9248	38.2820	38.4910	38.0783	38.0783	37.8799	37.6868	37.4990	37.3165	37.8799	37.4990	37.8799	(38)
Heat transfer coeff	95.4390	94.7962	95.0051	94.5925	94.5925	94.3941	94.2010	94.0131	93.8306	94.3941	94.0131	94.3941	(39)
Average = Sum(39)m / 12 =												94.4721	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1882	1.1802	1.1828	1.1777	1.1777	1.1752	1.1728	1.1705	1.1682	1.1752	1.1705	1.1752	(40)
HLP (average)												1.1762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	13.4839	0.4600	0.0000	0.7700	3.9163	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	118.3117	196.7976	326.3428	478.6552	557.8899	620.7696	586.1809	515.5297	400.7413	251.8266	147.0008	95.6685 (83)
Total gains	674.7072	748.7922	856.8850	975.9571	1021.1759	1053.5870	1001.1966	938.8371	843.1829	727.7204	660.0636	636.8350 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6401	34.8750	34.7983	34.9501	34.9501	35.0235	35.0953	35.1654	35.2338	35.0235	35.1654	35.0235	
alpha	3.3093	3.3250	3.3199	3.3300	3.3300	3.3349	3.3397	3.3444	3.3489	3.3349	3.3444	3.3349	
util living area	0.9621	0.9466	0.9028	0.8089	0.6702	0.4826	0.3587	0.3801	0.6200	0.8455	0.9383	0.9667	(86)
MIT	19.4851	19.6666	20.0487	20.4893	20.7953	20.9493	20.9858	20.9832	20.8826	20.5018	19.9499	19.4675	(87)
Th 2	19.9294	19.9358	19.9338	19.9379	19.9379	19.9399	19.9418	19.9437	19.9455	19.9399	19.9437	19.9399	(88)
util rest of house	0.9546	0.9364	0.8841	0.7735	0.6116	0.4024	0.2650	0.2817	0.5394	0.8070	0.9241	0.9600	(89)
MIT 2	17.9535	18.2164	18.7540	19.3551	19.7397	19.9047	19.9358	19.9365	19.8516	19.3908	18.6317	17.9357	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.3372	18.5797	19.0784	19.6392	20.0041	20.1664	20.1988	20.1987	20.1099	19.6691	18.9619	18.3194	(92)

Temperature adjustment -0.1500

adjusted MIT	18.1872	18.4297	18.9284	19.4892	19.8541	20.0164	20.0488	20.0487	19.9599	19.5191	18.8119	18.1694	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9379	0.9173	0.8625	0.7565	0.6066	0.4084	0.2747	0.2917	0.5406	0.7888	0.9043	0.9445	(94)
Useful gains	632.8252	686.8450	739.0533	738.2791	619.4212	430.3072	274.9963	273.8926	455.8183	574.0381	596.9012	601.5130	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1268.1137	1244.6420	1133.2556	944.9031	695.6460	445.1982	277.7802	277.2134	493.5363	766.3958	1025.8618	1243.1136	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.6546	374.8396	293.2865	148.7693	56.7112	0.0000	0.0000	0.0000	0.0000	143.1141	308.8516	477.3509	(98)

Space heating 2275.5778 (98)
RHI space heating demand 2276 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.3800	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4482	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4130	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.4124	(36)
Total fabric heat loss	(33) + (36) = 56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1389	40.8717	40.6099	39.3798	39.1497	38.0783	38.0783	37.8799	38.4910	39.1497	39.6152	40.1020	(38)
Heat transfer coeff	97.6531	97.3859	97.1240	95.8940	95.6638	94.5925	94.5925	94.3941	95.0051	95.6638	96.1294	96.6161	(39)
Average = Sum(39)m / 12 =												95.8929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2158	1.2125	1.2092	1.1939	1.1910	1.1777	1.1777	1.1752	1.1828	1.1910	1.1968	1.2029	(40)
HLP (average)												1.1939	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	648.6673	732.3584	827.8846	932.4407	998.5231	981.7445	937.1889	870.4234	788.6572	689.9329	628.0739	617.0812	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8547	33.9476	34.0391	34.4757	34.5587	34.9501	34.9501	35.0235	34.7983	34.5587	34.3913	34.2180	
alpha	3.2570	3.2632	3.2693	3.2984	3.3039	3.3300	3.3300	3.3349	3.3199	3.3039	3.2928	3.2812	
util living area													
	0.9695	0.9537	0.9191	0.8433	0.7216	0.5627	0.4271	0.4730	0.6931	0.8847	0.9541	0.9736	(86)
MIT	19.3022	19.5254	19.9010	20.3625	20.7114	20.9094	20.9726	20.9615	20.8139	20.3441	19.7449	19.2616	(87)
Th 2	19.9074	19.9100	19.9126	19.9249	19.9272	19.9379	19.9379	19.9399	19.9338	19.9272	19.9225	19.9177	(88)
util rest of house													
	0.9635	0.9448	0.9032	0.8130	0.6696	0.4854	0.3309	0.3740	0.6200	0.8552	0.9436	0.9684	(89)
MIT 2	17.6758	17.9976	18.5329	19.1782	19.6312	19.8667	19.9237	19.9183	19.7703	19.1720	18.3262	17.6240	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0832	18.3803	18.8756	19.4749	19.9018	20.1279	20.1865	20.1796	20.0317	19.4656	18.6816	18.0342	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9332	18.2303	18.7256	19.3249	19.7518	19.9779	20.0365	20.0296	19.8817	19.3156	18.5316	17.8842	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.9263	0.8815	0.7933	0.6602	0.4885	0.3401	0.3828	0.6160	0.8344	0.9253	0.9545	(94)
Useful gains	615.1128	678.3589	729.7427	739.7271	659.2359	479.5682	318.7548	333.1776	485.8108	575.7022	581.1731	589.0007	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1331.3223	1298.1862	1187.4022	999.6808	770.2667	508.7102	325.0661	342.6153	549.2886	833.7699	1098.9091	1322.1167	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	532.8599	416.5240	340.4987	187.1667	82.6070	0.0000	0.0000	0.0000	0.0000	192.0024	372.7699	545.4384	(98)
Space heating												2669.8668	(98)
Space heating per m2											(98) / (4) =	33.2404	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2950.1291	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.8599	416.5240	340.4987	187.1667	82.6070	0.0000	0.0000	0.0000	0.0000	192.0024	372.7699	545.4384	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.7955	460.2475	376.2416	206.8141	91.2784	0.0000	0.0000	0.0000	0.0000	212.1573	411.9004	602.6943	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7184	89.6485	89.4909	89.1412	88.5228	87.3000	87.3000	87.3000	87.3000	89.1321	89.5616	89.7491	(217)
Fuel for water heating, kWh/month													
	185.1486	162.5053	169.0487	149.4738	145.5584	129.0595	121.2740	136.7748	137.7020	155.1567	166.6045	179.7451	(219)
Water heating fuel used												1838.0516	(219)
Annual totals kWh/year													
Space heating fuel - main system												2950.1291	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4145.7639	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2950.1291	3.4800	102.6645	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.0516	3.4800	63.9642	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	357.4827	13.1900	47.1520	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			201.8939	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6766	(257)
SAP value		90.5610	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2950.1291	0.2160	637.2279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.0516	0.2160	397.0191	(264)
Space and water heating			1034.2470	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			700.8327	(272)
CO2 emissions per m2			8.7300	(273)
EI value			92.5063	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3800	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3691	0.3427	0.3515	0.3339	0.3339	0.3251	0.3163	0.3076	0.2988	0.3251	0.3076	0.3251	(22b)
Effective ac	0.5681	0.5587	0.5618	0.5557	0.5557	0.5529	0.5500	0.5473	0.5446	0.5529	0.5473	0.5529	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124	(36)
Total fabric heat loss	(33) + (36) =	56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9248	38.2820	38.4910	38.0783	38.0783	37.8799	37.6868	37.4990	37.3165	37.8799	37.4990	37.8799	(38)
Heat transfer coeff	95.4390	94.7962	95.0051	94.5925	94.5925	94.3941	94.2010	94.0131	93.8306	94.3941	94.0131	94.3941	(39)
Average = Sum(39)m / 12 =												94.4721	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1882	1.1802	1.1828	1.1777	1.1777	1.1752	1.1728	1.1705	1.1682	1.1752	1.1705	1.1752	(40)
HLP (average)												1.1762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	13.4839	0.4600	0.0000	0.7700	3.9163	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	118.3117	196.7976	326.3428	478.6552	557.8899	620.7696	586.1809	515.5297	400.7413	251.8266	147.0008	95.6685	(83)
Total gains	674.7072	748.7922	856.8850	975.9571	1021.1759	1053.5870	1001.1966	938.8371	843.1829	727.7204	660.0636	636.8350	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6401	34.8750	34.7983	34.9501	34.9501	35.0235	35.0953	35.1654	35.2338	35.0235	35.1654	35.0235	
alpha	3.3093	3.3250	3.3199	3.3300	3.3300	3.3349	3.3397	3.3444	3.3489	3.3349	3.3444	3.3349	
util living area													
	0.9621	0.9466	0.9028	0.8089	0.6702	0.4826	0.3587	0.3801	0.6200	0.8455	0.9383	0.9667	(86)
MIT	19.4851	19.6666	20.0487	20.4893	20.7953	20.9493	20.9858	20.9832	20.8826	20.5018	19.9499	19.4675	(87)
Th 2	19.9294	19.9358	19.9338	19.9379	19.9379	19.9399	19.9418	19.9437	19.9455	19.9399	19.9437	19.9399	(88)
util rest of house													
	0.9546	0.9364	0.8841	0.7735	0.6116	0.4024	0.2650	0.2817	0.5394	0.8070	0.9241	0.9600	(89)
MIT 2	17.9535	18.2164	18.7540	19.3551	19.7397	19.9047	19.9358	19.9365	19.8516	19.3908	18.6317	17.9357	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3372	18.5797	19.0784	19.6392	20.0041	20.1664	20.1988	20.1987	20.1099	19.6691	18.9619	18.3194	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1872	18.4297	18.9284	19.4892	19.8541	20.0164	20.0488	20.0487	19.9599	19.5191	18.8119	18.1694	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9379	0.9173	0.8625	0.7565	0.6066	0.4084	0.2747	0.2917	0.5406	0.7888	0.9043	0.9445	(94)
Useful gains	632.8252	686.8450	739.0533	738.2791	619.4212	430.3072	274.9963	273.8926	455.8183	574.0381	596.9012	601.5130	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1268.1137	1244.6420	1133.2556	944.9031	695.6460	445.1982	277.7802	277.2134	493.5363	766.3958	1025.8618	1243.1136	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	472.6546	374.8396	293.2865	148.7693	56.7112	0.0000	0.0000	0.0000	0.0000	143.1141	308.8516	477.3509	(98)
Space heating												2275.5778	(98)
Space heating per m2											(98) / (4) =	28.3314	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2514.4506	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	472.6546	374.8396	293.2865	148.7693	56.7112	0.0000	0.0000	0.0000	0.0000	143.1141	308.8516	477.3509	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	522.2703	414.1874	324.0735	164.3859	62.6643	0.0000	0.0000	0.0000	0.0000	158.1372	341.2725	527.4595	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6455	89.5810	89.3851	88.9594	88.2537	87.3000	87.3000	87.3000	87.3000	88.8986	89.4321	89.6698	(217)
Fuel for water heating, kWh/month													
	185.2993	162.6278	169.2489	149.7794	146.0022	129.0595	121.2740	136.7748	137.7020	155.5642	166.8456	179.9041	(219)
Water heating fuel used												1840.0818	(219)
Annual totals kWh/year													
Space heating fuel - main system												2514.4506	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3566.2905	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2514.4506	9.7400	244.9075	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.0818	9.7400	179.2240	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	357.4827	36.8500	131.7324	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			237.6643	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2514.4506	0.2160	543.1213	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.0818	0.2160	397.4577	(264)
Space and water heating			940.5790	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			531.4814	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2514.4506	1.2200	3067.6298	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.0818	1.2200	2244.8997	(264)
Space and water heating			5312.5295	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	357.4827	3.0700	1097.4719	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2892.6268	(272)
Primary energy kWh/m2/year			36.0138	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (34.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 92	A 94
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£178	-£18
Mains gas	£528	£433	£95
Space heating	£377	£377	£0
Water heating	£179	£102	£77
Lighting	£132	£132	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£237	£161	£77
Total cost of uses	£238	£161	£77
Delivered energy	44 kWh/m²	33 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	36 kWh/m²	23 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3800	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4482	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4130	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124 (36)
Total fabric heat loss	(33) + (36) =	56.5142 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.1389	40.8717	40.6099	39.3798	39.1497	38.0783	38.0783	37.8799	38.4910	39.1497	39.6152	40.1020	(38)
Heat transfer coeff	97.6531	97.3859	97.1240	95.8940	95.6638	94.5925	94.5925	94.3941	95.0051	95.6638	96.1294	96.6161	(39)
Average = Sum(39)m / 12 =												95.8929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2158	1.2125	1.2092	1.1939	1.1910	1.1777	1.1777	1.1752	1.1828	1.1910	1.1968	1.2029	(40)
HLP (average)												1.1939	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)

Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147 (83)
Total gains	648.6673	732.3584	827.8846	932.4407	998.5231	981.7445	937.1889	870.4234	788.6572	689.9329	628.0739	617.0812 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8547	33.9476	34.0391	34.4757	34.5587	34.9501	34.9501	35.0235	34.7983	34.5587	34.3913	34.2180	
alpha	3.2570	3.2632	3.2693	3.2984	3.3039	3.3300	3.3300	3.3349	3.3199	3.3039	3.2928	3.2812	
util living area	0.9695	0.9537	0.9191	0.8433	0.7216	0.5627	0.4271	0.4730	0.6931	0.8847	0.9541	0.9736	(86)
MIT	19.3022	19.5254	19.9010	20.3625	20.7114	20.9094	20.9726	20.9615	20.8139	20.3441	19.7449	19.2616	(87)
Th 2	19.9074	19.9100	19.9126	19.9249	19.9272	19.9379	19.9379	19.9399	19.9338	19.9272	19.9225	19.9177	(88)
util rest of house	0.9635	0.9448	0.9032	0.8130	0.6696	0.4854	0.3309	0.3740	0.6200	0.8552	0.9436	0.9684	(89)
MIT 2	17.6758	17.9976	18.5329	19.1782	19.6312	19.8667	19.9237	19.9183	19.7703	19.1720	18.3262	17.6240	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0832	18.3803	18.8756	19.4749	19.9018	20.1279	20.1865	20.1796	20.0317	19.4656	18.6816	18.0342	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9332	18.2303	18.7256	19.3249	19.7518	19.9779	20.0365	20.0296	19.8817	19.3156	18.5316	17.8842	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.9263	0.8815	0.7933	0.6602	0.4885	0.3401	0.3828	0.6160	0.8344	0.9253	0.9545	(94)
Useful gains	615.1128	678.3589	729.7427	739.7271	659.2359	479.5682	318.7548	333.1776	485.8108	575.7022	581.1731	589.0007	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1331.3223	1298.1862	1187.4022	999.6808	770.2667	508.7102	325.0661	342.6153	549.2886	833.7699	1098.9091	1322.1167	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	532.8599	416.5240	340.4987	187.1667	82.6070	0.0000	0.0000	0.0000	0.0000	192.0024	372.7699	545.4384	(98)
Space heating												2669.8668	(98)
Space heating per m2											(98) / (4) =	33.2404	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2950.1291	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.8599	416.5240	340.4987	187.1667	82.6070	0.0000	0.0000	0.0000	0.0000	192.0024	372.7699	545.4384	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.7955	460.2475	376.2416	206.8141	91.2784	0.0000	0.0000	0.0000	0.0000	212.1573	411.9004	602.6943	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8088	89.8379	89.8626	89.9198	90.0324	87.3000	87.3000	87.3000	87.3000	89.4848	89.6985	89.8243	(217)
Fuel for water heating, kWh/month													
	157.6987	116.6823	90.9124	44.4646	15.1469	0.0000	0.0000	24.9065	50.0868	96.1750	133.9719	156.7835	(219)
Water heating fuel used												886.8285	(219)
Annual totals kWh/year													
Space heating fuel - main system												2950.1291	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3244.5408	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2950.1291	3.4800	102.6645	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.8285	3.4800	30.8616	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	357.4827	13.1900	47.1520	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			175.3864	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5878	(257)
SAP value	91.8003	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2950.1291	0.2160	637.2279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.8285	0.2160	191.5549	(264)
Space and water heating			828.7828	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			521.3185	(272)
CO2 emissions per m2			6.4900	(273)
EI value			94.4257	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3800	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3515	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3691	0.3427	0.3515	0.3339	0.3339	0.3251	0.3163	0.3076	0.2988	0.3251	0.3076	0.3251	(22b)
Effective ac	0.5681	0.5587	0.5618	0.5557	0.5557	0.5529	0.5500	0.5473	0.5446	0.5529	0.5473	0.5529	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124 (36)
Total fabric heat loss	(33) + (36) =	56.5142 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.9248	38.2820	38.4910	38.0783	38.0783	37.8799	37.6868	37.4990	37.3165	37.8799	37.4990	37.8799	(38)
Heat transfer coeff	95.4390	94.7962	95.0051	94.5925	94.5925	94.3941	94.2010	94.0131	93.8306	94.3941	94.0131	94.3941	(39)
Average = Sum(39)m / 12 =												94.4721	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1882	1.1802	1.1828	1.1777	1.1777	1.1752	1.1728	1.1705	1.1682	1.1752	1.1705	1.1752	(40)
HLP (average)												1.1762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
             166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3896 (H8)
Utilisation factor                                                                                                                  0.5131 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.8365 (H14)
Volume ratio Veff/V                                                                                                                 0.8079 (H15)
Solar storage volume factor                                                                                                         0.9573 (H16)
Solar input                                                                                                                      -876.6189 (H17)
Solar input    -28.5974   -40.6637   -69.8912   -94.2994  -110.7603  -118.3095  -115.8214  -103.6637   -81.1615   -56.1123   -33.8232   -23.5154 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =   -876.6189 (63)
Output from w/h
             137.5150   105.0198    81.3921    38.9434    18.0921     0.0000     0.0000    15.7407    39.0524    82.1821   115.3904   137.8042 (64)
                                                                                                Total per year (kWh/year) = Sum(64)m =     771.1322 (64)
Heat gains from water heating, kWh/month
              54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m       148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.6054    44.9472    36.5536    27.6734    20.6862    17.4642    18.8706    24.5288    32.9224    41.8026    48.7898    52.0119 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
              72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
             556.3955   551.9947   530.5421   497.3019   463.2860   432.8174   415.0157   423.3074   442.4416   475.8938   513.0628   541.1665 (73)
```

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	13.4839	0.4600	0.0000	0.7700	3.9163	(74)
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

```
Solar gains    118.3117   196.7976   326.3428   478.6552   557.8899   620.7696   586.1809   515.5297   400.7413   251.8266   147.0008    95.6685 (83)
Total gains    674.7072   748.7922   856.8850   975.9571  1021.1759  1053.5870  1001.1966   938.8371   843.1829   727.7204   660.0636   636.8350 (84)
```

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau         34.6401    34.8750    34.7983    34.9501    34.9501    35.0235    35.0953    35.1654    35.2338    35.0235    35.1654    35.0235
alpha        3.3093     3.3250     3.3199     3.3300     3.3300     3.3349     3.3397     3.3444     3.3489     3.3349     3.3444     3.3349
util living area
               0.9621     0.9466     0.9028     0.8089     0.6702     0.4826     0.3587     0.3801     0.6200     0.8455     0.9383     0.9667 (86)

MIT         19.4851    19.6666    20.0487    20.4893    20.7953    20.9493    20.9858    20.9832    20.8826    20.5018    19.9499    19.4675 (87)
Th 2        19.9294    19.9358    19.9338    19.9379    19.9379    19.9399    19.9418    19.9437    19.9455    19.9399    19.9437    19.9399 (88)
util rest of house
               0.9546     0.9364     0.8841     0.7735     0.6116     0.4024     0.2650     0.2817     0.5394     0.8070     0.9241     0.9600 (89)
MIT 2       17.9535    18.2164    18.7540    19.3551    19.7397    19.9047    19.9358    19.9365    19.8516    19.3908    18.6317    17.9357 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.2505 (91)
MIT         18.3372    18.5797    19.0784    19.6392    20.0041    20.1664    20.1988    20.1987    20.1099    19.6691    18.9619    18.3194 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT    18.1872    18.4297    18.9284    19.4892    19.8541    20.0164    20.0488    20.0487    19.9599    19.5191    18.8119    18.1694 (93)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9379	0.9173	0.8625	0.7565	0.6066	0.4084	0.2747	0.2917	0.5406	0.7888	0.9043	0.9445	(94)
Useful gains	632.8252	686.8450	739.0533	738.2791	619.4212	430.3072	274.9963	273.8926	455.8183	574.0381	596.9012	601.5130	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1268.1137	1244.6420	1133.2556	944.9031	695.6460	445.1982	277.7802	277.2134	493.5363	766.3958	1025.8618	1243.1136	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	472.6546	374.8396	293.2865	148.7693	56.7112	0.0000	0.0000	0.0000	0.0000	143.1141	308.8516	477.3509	(98)
Space heating												2275.5778	(98)
Space heating per m2											(98) / (4) =	28.3314	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2514.4506	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	472.6546	374.8396	293.2865	148.7693	56.7112	0.0000	0.0000	0.0000	0.0000	143.1141	308.8516	477.3509	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	522.2703	414.1874	324.0735	164.3859	62.6643	0.0000	0.0000	0.0000	0.0000	158.1372	341.2725	527.4595	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7585	89.7798	89.7851	89.8170	89.7047	87.3000	87.3000	87.3000	87.3000	89.3059	89.6066	89.7629	(217)
Fuel for water heating, kWh/month													
	153.2056	116.9749	90.6521	43.3586	20.1685	0.0000	0.0000	18.0306	44.7335	92.0232	128.7744	153.5202	(219)
Water heating fuel used												861.4416	(219)
Annual totals kWh/year													
Space heating fuel - main system												2514.4506	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												2637.6503	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2514.4506	9.7400	244.9075	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.4416	9.7400	83.9044	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	357.4827	36.8500	131.7324	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			160.7697	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2514.4506	0.2160	543.1213	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.4416	0.2160	186.0714	(264)
Space and water heating			729.1927	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561 (269)
Total kg/year			346.0451 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2514.4506	1.2200	3067.6298	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.4416	1.2200	1050.9587	(264)
Space and water heating			4118.5885	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	357.4827	3.0700	1097.4719	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1852.1857	(272)
Primary energy kWh/m2/year			23.0601	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	148.2 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07 (P1)
Transmission heat loss coefficient	56.51 (37)
Summer heat loss coefficient	330.58 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.8200	81.1852	0.4600	0.0000	0.9000	27.5607
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						651.2272

	Jun	Jul	Aug	
Solar gains	692	651	571	(P4)
Internal gains	430	412	420	
Total summer gains	1122	1063	991	(P5)
Summer gain/loss ratio	3.39	3.22	3.00	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 148.2)	0.96	0.96	0.96	
Threshold temperature	20.36	22.08	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-348	**Issued on Date**	19/04/2023
Assessment Reference	As Built	**Prop Type Ref**	2-Opp-SEMI
Property	8, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	9.99	**TER**	18.65
Environmental	93 A	**% DER<TER**	46.43		
CO_2 Emissions (t/year)	0.51	**DFEE**	46.29	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.36		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.80 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 3.63 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.8000	
Infiltration rate		0.3845	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4535	0.4446	0.4357	0.3912	0.3823	0.3379	0.3379	0.3290	0.3557	0.3823	0.4001	0.4179	(22b)
Effective ac	0.6028	0.5988	0.5949	0.5765	0.5731	0.5571	0.5571	0.5541	0.5632	0.5731	0.5800	0.5873	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3028	41.0293	40.7612	39.5018	39.2662	38.1693	38.1693	37.9662	38.5918	39.2662	39.7429	40.2412	(38)
Heat transfer coeff	99.7710	99.4974	99.2293	97.9699	97.7343	96.6374	96.6374	96.4343	97.0599	97.7343	98.2110	98.7093	(39)
Average = Sum(39)m / 12 =												97.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2422	1.2388	1.2354	1.2197	1.2168	1.2032	1.2032	1.2006	1.2084	1.2168	1.2227	1.2290	(40)
HLP (average)												1.2197	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8958	32.9862	33.0753	33.5005	33.5813	33.9624	33.9624	34.0340	33.8146	33.5813	33.4183	33.2496	
alpha	3.1931	3.1991	3.2050	3.2334	3.2388	3.2642	3.2642	3.2689	3.2543	3.2388	3.2279	3.2166	
util living area													
	0.9844	0.9707	0.9401	0.8711	0.7552	0.5998	0.4607	0.5110	0.7358	0.9170	0.9742	0.9873	(86)
MIT	19.0242	19.2989	19.7293	20.2484	20.6484	20.8831	20.9630	20.9479	20.7629	20.2051	19.5158	18.9783	(87)
Th 2	19.8864	19.8891	19.8918	19.9042	19.9066	19.9175	19.9175	19.9195	19.9133	19.9066	19.9018	19.8969	(88)
util rest of house													
	0.9811	0.9646	0.9275	0.8441	0.7047	0.5197	0.3572	0.4052	0.6641	0.8935	0.9678	0.9846	(89)
MIT 2	17.2636	17.6624	18.2806	19.0134	19.5410	19.8242	19.8981	19.8899	19.7003	18.9738	17.9885	17.2033	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7046	18.0724	18.6435	19.3228	19.8184	20.0895	20.1648	20.1549	19.9665	19.2822	18.3711	17.6479	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5546	17.9224	18.4935	19.1728	19.6684	19.9395	20.0148	20.0049	19.8165	19.1322	18.2211	17.4979	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9494	0.9067	0.8224	0.6924	0.5214	0.3669	0.4140	0.6568	0.8719	0.9536	0.9757	(94)
Useful gains	490.9445	583.8410	664.2841	702.0506	643.9876	478.2127	321.3644	334.7305	473.7708	522.5392	481.6147	461.5082	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1322.4289	1295.6941	1190.1088	1006.4245	778.7890	515.9937	330.0002	347.6365	554.8384	833.8902	1092.2150	1312.6300	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	618.6244	478.3653	391.2136	219.1492	100.2923	0.0000	0.0000	0.0000	0.0000	231.6451	439.6322	633.2346	(98)
Space heating												3112.1566	(98)
Space heating per m2											(98) / (4) =	38.7470	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3438.8471	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	618.6244	478.3653	391.2136	219.1492	100.2923	0.0000	0.0000	0.0000	0.0000	231.6451	439.6322	633.2346	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	683.5628	528.5804	432.2802	242.1538	110.8202	0.0000	0.0000	0.0000	0.0000	255.9615	485.7814	699.7068	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8032	89.7322	89.5843	89.2628	88.6723	87.3000	87.3000	87.3000	87.3000	89.2767	89.6671	89.8315	(217)
Fuel for water heating, kWh/month													
	184.9739	162.3538	168.8725	149.2701	145.3130	129.0595	121.2740	136.7748	137.7020	154.9054	166.4084	179.5803	(219)
Water heating fuel used												1836.4877	(219)
Annual totals kWh/year													
Space heating fuel - main system												3438.8471	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4626.4815	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3438.8471	0.2160	742.7910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4877	0.2160	396.6813	(264)
Space and water heating			1139.4723	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			802.7175	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.9900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		28.4483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.4483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3945	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9281	(36)
Total fabric heat loss	(33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689	(42)
Average daily hot water use (litres/day)		92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3845	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4535	0.4446	0.4357	0.3912	0.3823	0.3379	0.3379	0.3290	0.3557	0.3823	0.4001	0.4179	(22b)
Effective ac	0.6028	0.5988	0.5949	0.5765	0.5731	0.5571	0.5571	0.5541	0.5632	0.5731	0.5800	0.5873	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3028	41.0293	40.7612	39.5018	39.2662	38.1693	38.1693	37.9662	38.5918	39.2662	39.7429	40.2412	(38)
Heat transfer coeff	99.7710	99.4974	99.2293	97.9699	97.7343	96.6374	96.6374	96.4343	97.0599	97.7343	98.2110	98.7093	(39)
Average = Sum(39)m / 12 =												97.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2422	1.2388	1.2354	1.2197	1.2168	1.2032	1.2032	1.2006	1.2084	1.2168	1.2227	1.2290	(40)
HLP (average)												1.2197	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)

Pumps, fans

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)

Water heating gains (Table 5)

43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)

Total internal gains

343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8958	32.9862	33.0753	33.5005	33.5813	33.9624	33.9624	34.0340	33.8146	33.5813	33.4183	33.2496	
alpha	3.1931	3.1991	3.2050	3.2334	3.2388	3.2642	3.2642	3.2689	3.2543	3.2388	3.2279	3.2166	
util living area	0.9871	0.9745	0.9459	0.8797	0.7663	0.6116	0.4712	0.5241	0.7502	0.9257	0.9782	0.9896	(86)
MIT	18.9724	19.2509	19.6885	20.2193	20.6316	20.8761	20.9604	20.9438	20.7478	20.1701	19.4687	18.9271	(87)
Th 2	19.8864	19.8891	19.8918	19.9042	19.9066	19.9175	19.9175	19.9195	19.9133	19.9066	19.9018	19.8969	(88)
util rest of house	0.9843	0.9692	0.9343	0.8539	0.7166	0.5311	0.3660	0.4167	0.6796	0.9041	0.9727	0.9873	(89)
MIT 2	18.0445	18.3218	18.7528	19.2699	19.6437	19.8496	19.9032	19.8975	19.7573	19.2376	18.5494	18.0071	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2770	18.5545	18.9872	19.5078	19.8912	20.1068	20.1681	20.1596	20.0054	19.4712	18.7797	18.2376	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2770	18.5545	18.9872	19.5078	19.8912	20.1068	20.1681	20.1596	20.0054	19.4712	18.7797	18.2376	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9226	0.8430	0.7159	0.5461	0.3914	0.4418	0.6863	0.8934	0.9652	0.9827	(94)
Useful gains	463.3237	560.4767	648.3076	696.2318	646.9654	487.5410	333.9057	346.2728	477.4617	510.5540	458.0890	433.7803	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1394.4950	1358.5905	1239.0971	1039.2419	800.5575	532.1603	344.8095	362.5580	573.1768	867.0243	1147.0743	1385.6374	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	692.7915	536.3325	439.5474	246.9673	114.2725	0.0000	0.0000	0.0000	0.0000	265.2139	496.0694	708.1817	(98)
Space heating												3499.3761	(98)
Space heating per m2										(98) / (4) =		43.5679	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	908.3920	715.1171	732.9009	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8428	0.8953	0.8704	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	765.5800	640.2595	637.9528	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	266.4790	332.7525	275.1872	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												874.4188	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.6197	83.1881	68.7968	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												218.6047	(107)
Space cooling per m2												2.7217	(108)
Energy for space heating												43.5679	(99)
Energy for space cooling												2.7217	(108)
Total												46.2896	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	44.2481	62.1032	49.3797	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												155.7311 (107)
Space cooling per m2												1.9389 (108)
Energy for space heating												45.0622 (99)
Energy for space cooling												1.9389 (108)
Total												47.0011 (109)
Target Fabric Energy Efficiency (TFEE)												54.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3845	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3734	0.3468	0.3557	0.3379	0.3379	0.3290	0.3201	0.3112	0.3023	0.3290	0.3112	0.3290	(22b)
Effective ac	0.5697	0.5601	0.5632	0.5571	0.5571	0.5541	0.5512	0.5484	0.5457	0.5541	0.5484	0.5541	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0360	38.3779	38.5918	38.1693	38.1693	37.9662	37.7685	37.5762	37.3893	37.9662	37.5762	37.9662	(38)
Heat transfer coeff	97.5041	96.8460	97.0599	96.6374	96.6374	96.4343	96.2366	96.0443	95.8575	96.4343	96.0443	96.4343	(39)
Average = Sum(39)m / 12 =												96.5142	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2139	1.2058	1.2084	1.2032	1.2032	1.2006	1.1982	1.1958	1.1934	1.2006	1.1958	1.2006	(40)
HLP (average)												1.2016	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946 (83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6606	33.8893	33.8146	33.9624	33.9624	34.0340	34.1039	34.1722	34.2388	34.0340	34.1722	34.0340	
alpha	3.2440	3.2593	3.2543	3.2642	3.2642	3.2689	3.2736	3.2781	3.2826	3.2689	3.2781	3.2689	
util living area	0.9553	0.9355	0.8844	0.7839	0.6450	0.4608	0.3408	0.3587	0.5858	0.8188	0.9262	0.9612	(86)
MIT	19.4964	19.6984	20.0899	20.5184	20.8070	20.9523	20.9866	20.9845	20.8946	20.5354	19.9764	19.4710	(87)
Th 2	19.9089	19.9154	19.9133	19.9175	19.9175	19.9195	19.9215	19.9234	19.9252	19.9195	19.9234	19.9195	(88)
util rest of house	0.9466	0.9234	0.8631	0.7461	0.5854	0.3819	0.2497	0.2635	0.5054	0.7764	0.9098	0.9535	(89)
MIT 2	17.9566	18.2473	18.7943	19.3738	19.7328	19.8868	19.9159	19.9169	19.8425	19.4152	18.6542	17.9279	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.3423	18.6108	19.1189	19.6605	20.0019	20.1537	20.1841	20.1843	20.1061	19.6958	18.9854	18.3145	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1923	18.4608	18.9689	19.5105	19.8519	20.0037	20.0341	20.0343	19.9561	19.5458	18.8354	18.1645	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9026	0.8408	0.7301	0.5815	0.3883	0.2594	0.2736	0.5078	0.7593	0.8886	0.9363	(94)
Useful gains	667.8384	731.5463	784.8378	772.5551	638.7636	439.6518	279.7658	278.7962	470.1906	606.5239	633.4968	631.9502	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1296.0529	1274.5721	1161.6984	967.3917	710.4697	453.5996	282.3679	281.8239	503.8337	785.5317	1050.2866	1269.5076	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.3916	364.9134	280.3842	140.2824	53.3493	0.0000	0.0000	0.0000	0.0000	133.1818	300.0887	474.3427	(98)

Space heating 2213.9341 (98)
RHI space heating demand 2214 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.8000	
Infiltration rate		0.3845	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4535	0.4446	0.4357	0.3912	0.3823	0.3379	0.3379	0.3290	0.3557	0.3823	0.4001	0.4179	(22b)
Effective ac	0.6028	0.5988	0.5949	0.5765	0.5731	0.5571	0.5571	0.5541	0.5632	0.5731	0.5800	0.5873	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3028	41.0293	40.7612	39.5018	39.2662	38.1693	38.1693	37.9662	38.5918	39.2662	39.7429	40.2412	(38)
Heat transfer coeff	99.7710	99.4974	99.2293	97.9699	97.7343	96.6374	96.6374	96.4343	97.0599	97.7343	98.2110	98.7093	(39)
Average = Sum(39)m / 12 =												97.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2422	1.2388	1.2354	1.2197	1.2168	1.2032	1.2032	1.2006	1.2084	1.2168	1.2227	1.2290	(40)
HLP (average)												1.2197	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8958	32.9862	33.0753	33.5005	33.5813	33.9624	33.9624	34.0340	33.8146	33.5813	33.4183	33.2496	
alpha	3.1931	3.1991	3.2050	3.2334	3.2388	3.2642	3.2642	3.2689	3.2543	3.2388	3.2279	3.2166	
util living area													
	0.9646	0.9439	0.9027	0.8202	0.6957	0.5390	0.4063	0.4477	0.6596	0.8632	0.9458	0.9697	(86)
MIT	19.3006	19.5549	19.9427	20.3958	20.7282	20.9147	20.9744	20.9646	20.8309	20.3781	19.7596	19.2536	(87)
Th 2	19.8864	19.8891	19.8918	19.9042	19.9066	19.9175	19.9175	19.9195	19.9133	19.9066	19.9018	19.8969	(88)
util rest of house													
	0.9577	0.9333	0.8844	0.7872	0.6421	0.4621	0.3124	0.3511	0.5848	0.8300	0.9337	0.9637	(89)
MIT 2	17.6610	18.0257	18.5751	19.2037	19.6310	19.8514	19.9044	19.9001	19.7676	19.1998	18.3335	17.6001	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0717	18.4088	18.9177	19.5023	19.9058	20.1177	20.1724	20.1667	20.0340	19.4950	18.6907	18.0143	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9217	18.2588	18.7677	19.3523	19.7558	19.9677	20.0224	20.0167	19.8840	19.3450	18.5407	17.8643	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9409	0.9128	0.8615	0.7682	0.6341	0.4658	0.3218	0.3602	0.5826	0.8094	0.9137	0.9483	(94)
Useful gains	645.0575	723.5322	777.5586	777.5924	682.8710	491.4127	324.8649	340.1819	504.0337	610.5840	613.9129	615.3800	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1359.0496	1329.1645	1217.3138	1024.0085	787.3324	518.7235	330.7365	348.7767	561.3899	854.6839	1123.6067	1348.7923	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	531.2101	406.9849	327.1779	177.4196	77.7193	0.0000	0.0000	0.0000	0.0000	181.6103	366.9796	545.6588	(98)
Space heating												2614.7604	(98)
Space heating per m2											(98) / (4) =	32.5543	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2889.2381	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	531.2101	406.9849	327.1779	177.4196	77.7193	0.0000	0.0000	0.0000	0.0000	181.6103	366.9796	545.6588	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	586.9725	449.7071	361.5225	196.0437	85.8777	0.0000	0.0000	0.0000	0.0000	200.6744	405.5023	602.9379	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7166	89.6339	89.4631	89.0992	88.4770	87.3000	87.3000	87.3000	87.3000	89.0883	89.5511	89.7493	(217)
Fuel for water heating, kWh/month													
	185.1524	162.5317	169.1012	149.5442	145.6337	129.0595	121.2740	136.7748	137.7020	155.2329	166.6239	179.7447	(219)
Water heating fuel used												1838.3750	(219)
Annual totals kWh/year													
Space heating fuel - main system												2889.2381	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4078.7597	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2889.2381	3.4800	100.5455	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3750	3.4800	63.9754	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			198.9372	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6667	(257)
SAP value		90.6992	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2889.2381	0.2160	624.0754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3750	0.2160	397.0890	(264)
Space and water heating			1021.1644	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			684.4096	(272)
CO2 emissions per m2			8.5200	(273)
EI value			92.6819	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8866 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3845	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3734	0.3468	0.3557	0.3379	0.3379	0.3290	0.3201	0.3112	0.3023	0.3290	0.3112	0.3290	(22b)
Effective ac	0.5697	0.5601	0.5632	0.5571	0.5571	0.5541	0.5512	0.5484	0.5457	0.5541	0.5484	0.5541	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0360	38.3779	38.5918	38.1693	38.1693	37.9662	37.7685	37.5762	37.3893	37.9662	37.5762	37.9662	(38)
Heat transfer coeff	97.5041	96.8460	97.0599	96.6374	96.6374	96.4343	96.2366	96.0443	95.8575	96.4343	96.0443	96.4343	(39)
Average = Sum(39)m / 12 =												96.5142	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2139	1.2058	1.2084	1.2032	1.2032	1.2006	1.1982	1.1958	1.1934	1.2006	1.1958	1.2006	(40)
HLP (average)												1.2016	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946	(83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6606	33.8893	33.8146	33.9624	33.9624	34.0340	34.1039	34.1722	34.2388	34.0340	34.1722	34.0340	
alpha	3.2440	3.2593	3.2543	3.2642	3.2642	3.2689	3.2736	3.2781	3.2826	3.2689	3.2781	3.2689	
util living area													
	0.9553	0.9355	0.8844	0.7839	0.6450	0.4608	0.3408	0.3587	0.5858	0.8188	0.9262	0.9612	(86)
MIT	19.4964	19.6984	20.0899	20.5184	20.8070	20.9523	20.9866	20.9845	20.8946	20.5354	19.9764	19.4710	(87)
Th 2	19.9089	19.9154	19.9133	19.9175	19.9175	19.9195	19.9215	19.9234	19.9252	19.9195	19.9234	19.9195	(88)
util rest of house													
	0.9466	0.9234	0.8631	0.7461	0.5854	0.3819	0.2497	0.2635	0.5054	0.7764	0.9098	0.9535	(89)
MIT 2	17.9566	18.2473	18.7943	19.3738	19.7328	19.8868	19.9159	19.9169	19.8425	19.4152	18.6542	17.9279	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3423	18.6108	19.1189	19.6605	20.0019	20.1537	20.1841	20.1843	20.1061	19.6958	18.9854	18.3145	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1923	18.4608	18.9689	19.5105	19.8519	20.0037	20.0341	20.0343	19.9561	19.5458	18.8354	18.1645	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9026	0.8408	0.7301	0.5815	0.3883	0.2594	0.2736	0.5078	0.7593	0.8886	0.9363	(94)
Useful gains	667.8384	731.5463	784.8378	772.5551	638.7636	439.6518	279.7658	278.7962	470.1906	606.5239	633.4968	631.9502	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1296.0529	1274.5721	1161.6984	967.3917	710.4697	453.5996	282.3679	281.8239	503.8337	785.5317	1050.2866	1269.5076	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.3916	364.9134	280.3842	140.2824	53.3493	0.0000	0.0000	0.0000	0.0000	133.1818	300.0887	474.3427	(98)
Space heating												2213.9341	(98)
Space heating per m2											(98) / (4) =	27.5639	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2446.3360	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	467.3916	364.9134	280.3842	140.2824	53.3493	0.0000	0.0000	0.0000	0.0000	133.1818	300.0887	474.3427	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	516.4548	403.2192	309.8168	155.0081	58.9495	0.0000	0.0000	0.0000	0.0000	147.1622	331.5897	524.1356	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6384	89.5633	89.3522	88.9124	88.2133	87.3000	87.3000	87.3000	87.3000	88.8411	89.4116	89.6659	(217)
Fuel for water heating, kWh/month													
	185.3138	162.6599	169.3112	149.8585	146.0691	129.0595	121.2740	136.7748	137.7020	155.6649	166.8840	179.9119	(219)
Water heating fuel used												1840.4836	(219)
Annual totals kWh/year													
Space heating fuel - main system												2446.3360	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3492.1411	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2446.3360	9.7400	238.2731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.4836	9.7400	179.2631	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			228.6972	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2446.3360	0.2160	528.4086	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4836	0.2160	397.5445	(264)
Space and water heating			925.9530	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			513.5149	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2446.3360	1.2200	2984.5300	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4836	1.2200	2245.3900	(264)
Space and water heating			5229.9200	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2790.2569	(272)
Primary energy kWh/m2/year			34.7393	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (36.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.31 kg/m²	A 92	A 95
Total Savings	£77	2.31 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£157	£175	-£18
Mains gas	£522	£426	£95
Space heating	£370	£370	£0
Water heating	£179	£102	£77
Lighting	£129	£129	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£229	£151	£77
Total cost of uses	£228	£151	£77
Delivered energy	43 kWh/m²	32 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	35 kWh/m²	22 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.8000	
Infiltration rate		0.3845	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4535	0.4446	0.4357	0.3912	0.3823	0.3379	0.3379	0.3290	0.3557	0.3823	0.4001	0.4179	(22b)
Effective ac	0.6028	0.5988	0.5949	0.5765	0.5731	0.5571	0.5571	0.5541	0.5632	0.5731	0.5800	0.5873	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3028	41.0293	40.7612	39.5018	39.2662	38.1693	38.1693	37.9662	38.5918	39.2662	39.7429	40.2412	(38)
Heat transfer coeff	99.7710	99.4974	99.2293	97.9699	97.7343	96.6374	96.6374	96.4343	97.0599	97.7343	98.2110	98.7093	(39)
Average = Sum(39)m / 12 =												97.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2422	1.2388	1.2354	1.2197	1.2168	1.2032	1.2032	1.2006	1.2084	1.2168	1.2227	1.2290	(40)
HLP (average)												1.2197	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)
Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833 (83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8958	32.9862	33.0753	33.5005	33.5813	33.9624	33.9624	34.0340	33.8146	33.5813	33.4183	33.2496	
alpha	3.1931	3.1991	3.2050	3.2334	3.2388	3.2642	3.2642	3.2689	3.2543	3.2388	3.2279	3.2166	
util living area	0.9646	0.9439	0.9027	0.8202	0.6957	0.5390	0.4063	0.4477	0.6596	0.8632	0.9458	0.9697	(86)
MIT	19.3006	19.5549	19.9427	20.3958	20.7282	20.9147	20.9744	20.9646	20.8309	20.3781	19.7596	19.2536	(87)
Th 2	19.8864	19.8891	19.8918	19.9042	19.9066	19.9175	19.9175	19.9195	19.9133	19.9066	19.9018	19.8969	(88)
util rest of house	0.9577	0.9333	0.8844	0.7872	0.6421	0.4621	0.3124	0.3511	0.5848	0.8300	0.9337	0.9637	(89)
MIT 2	17.6610	18.0257	18.5751	19.2037	19.6310	19.8514	19.9044	19.9001	19.7676	19.1998	18.3335	17.6001	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0717	18.4088	18.9177	19.5023	19.9058	20.1177	20.1724	20.1667	20.0340	19.4950	18.6907	18.0143	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9217	18.2588	18.7677	19.3523	19.7558	19.9677	20.0224	20.0167	19.8840	19.3450	18.5407	17.8643	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9409	0.9128	0.8615	0.7682	0.6341	0.4658	0.3218	0.3602	0.5826	0.8094	0.9137	0.9483	(94)
Useful gains	645.0575	723.5322	777.5586	777.5924	682.8710	491.4127	324.8649	340.1819	504.0337	610.5840	613.9129	615.3800	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1359.0496	1329.1645	1217.3138	1024.0085	787.3324	518.7235	330.7365	348.7767	561.3899	854.6839	1123.6067	1348.7923	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	531.2101	406.9849	327.1779	177.4196	77.7193	0.0000	0.0000	0.0000	0.0000	181.6103	366.9796	545.6588	(98)
Space heating												2614.7604	(98)
Space heating per m2											(98) / (4) =	32.5543	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2889.2381	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	531.2101	406.9849	327.1779	177.4196	77.7193	0.0000	0.0000	0.0000	0.0000	181.6103	366.9796	545.6588	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	586.9725	449.7071	361.5225	196.0437	85.8777	0.0000	0.0000	0.0000	0.0000	200.6744	405.5023	602.9379	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8071	89.8256	89.8420	89.8940	90.0075	87.3000	87.3000	87.3000	87.3000	89.4458	89.6890	89.8246	(217)
Fuel for water heating, kWh/month													
	157.7017	116.6982	90.9332	44.4773	15.1511	0.0000	0.0000	24.9065	50.0868	96.2169	133.9860	156.7831	(219)
Water heating fuel used												886.9408	(219)
Annual totals kWh/year													
Space heating fuel - main system												2889.2381	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3177.3255	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2889.2381	3.4800	100.5455	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9408	3.4800	30.8655	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			172.4223	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5779	(257)
SAP value	91.9389	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2889.2381	0.2160	624.0754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9408	0.2160	191.5792	(264)
Space and water heating			815.6546	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			504.8498	(272)
CO2 emissions per m2			6.2900	(273)
EI value			94.6018	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.8000	
Infiltration rate		0.3845	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3557	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3734	0.3468	0.3557	0.3379	0.3379	0.3290	0.3201	0.3112	0.3023	0.3290	0.3112	0.3290	(22b)
Effective ac	0.5697	0.5601	0.5632	0.5571	0.5571	0.5541	0.5512	0.5484	0.5457	0.5541	0.5484	0.5541	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0360	38.3779	38.5918	38.1693	38.1693	37.9662	37.7685	37.5762	37.3893	37.9662	37.5762	37.9662	(38)
Heat transfer coeff	97.5041	96.8460	97.0599	96.6374	96.6374	96.4343	96.2366	96.0443	95.8575	96.4343	96.0443	96.4343	(39)
Average = Sum(39)m / 12 =												96.5142	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2139	1.2058	1.2084	1.2032	1.2032	1.2006	1.1982	1.1958	1.1934	1.2006	1.1958	1.2006	(40)
HLP (average)												1.2016	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3896	(H8)
Utilisation factor												0.5131	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-876.6189	(H17)
Solar input -28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154	(63)	
									Solar input (sum of months) = Sum(63)m =		-876.6189	(63)	
Output from w/h													
137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)	
									Total per year (kWh/year) = Sum(64)m =		771.1322	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	25.1925	0.4600	0.0000	0.7700	32.3912	(76)
South	2.4700	56.7559	0.4600	0.0000	0.7700	49.6542	(78)
West	4.6800	25.1925	0.4600	0.0000	0.7700	41.7606	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	164.0496	259.3220	403.5208	561.4014	635.5068	699.8045	663.6848	596.2917	484.0549	323.6539	200.7703	134.6946	(83)
Total gains	719.5340	810.5074	933.4048	1058.2050	1098.4204	1132.3075	1078.3607	1019.1575	925.9037	798.7950	712.9546	674.9246	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6606	33.8893	33.8146	33.9624	33.9624	34.0340	34.1039	34.1722	34.2388	34.0340	34.1722	34.0340	
alpha	3.2440	3.2593	3.2543	3.2642	3.2642	3.2689	3.2736	3.2781	3.2826	3.2689	3.2781	3.2689	
util living area													
	0.9553	0.9355	0.8844	0.7839	0.6450	0.4608	0.3408	0.3587	0.5858	0.8188	0.9262	0.9612	(86)
MIT	19.4964	19.6984	20.0899	20.5184	20.8070	20.9523	20.9866	20.9845	20.8946	20.5354	19.9764	19.4710	(87)
Th 2	19.9089	19.9154	19.9133	19.9175	19.9175	19.9195	19.9215	19.9234	19.9252	19.9195	19.9234	19.9195	(88)
util rest of house													
	0.9466	0.9234	0.8631	0.7461	0.5854	0.3819	0.2497	0.2635	0.5054	0.7764	0.9098	0.9535	(89)
MIT 2	17.9566	18.2473	18.7943	19.3738	19.7328	19.8868	19.9159	19.9169	19.8425	19.4152	18.6542	17.9279	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3423	18.6108	19.1189	19.6605	20.0019	20.1537	20.1841	20.1843	20.1061	19.6958	18.9854	18.3145	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1923	18.4608	18.9689	19.5105	19.8519	20.0037	20.0341	20.0343	19.9561	19.5458	18.8354	18.1645	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9282	0.9026	0.8408	0.7301	0.5815	0.3883	0.2594	0.2736	0.5078	0.7593	0.8886	0.9363	(94)
Useful gains	667.8384	731.5463	784.8378	772.5551	638.7636	439.6518	279.7658	278.7962	470.1906	606.5239	633.4968	631.9502	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1296.0529	1274.5721	1161.6984	967.3917	710.4697	453.5996	282.3679	281.8239	503.8337	785.5317	1050.2866	1269.5076	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.3916	364.9134	280.3842	140.2824	53.3493	0.0000	0.0000	0.0000	0.0000	133.1818	300.0887	474.3427	(98)
Space heating												2213.9341	(98)
Space heating per m2											(98) / (4) =	27.5639	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2446.3360	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	467.3916	364.9134	280.3842	140.2824	53.3493	0.0000	0.0000	0.0000	0.0000	133.1818	300.0887	474.3427	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	516.4548	403.2192	309.8168	155.0081	58.9495	0.0000	0.0000	0.0000	0.0000	147.1622	331.5897	524.1356	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7521	89.7647	89.7598	89.7849	89.6676	87.3000	87.3000	87.3000	87.3000	89.2516	89.5880	89.7593	(217)
Fuel for water heating, kWh/month	153.2165	116.9946	90.6776	43.3741	20.1768	0.0000	0.0000	18.0306	44.7335	92.0792	128.8012	153.5263	(219)
Water heating fuel used												861.6105	(219)
Annual totals kWh/year													
Space heating fuel - main system												2446.3360	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												2563.2680	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2446.3360	9.7400	238.2731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.6105	9.7400	83.9209	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	351.0461	36.8500	129.3605	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			151.7800	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2446.3360	0.2160	528.4086	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6105	0.2160	186.1079	(264)
Space and water heating			714.5165	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

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PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			328.0283	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2446.3360	1.2200	2984.5300	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6105	1.2200	1051.1648	(264)
Space and water heating			4035.6948	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1749.5317	(272)
Primary energy kWh/m2/year			21.7820	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-349	**Issued on Date**	31/05/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	7, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	10.45	**TER**	18.83
Environmental	92 A	**% DER<TER**	44.51		
CO_2 Emissions (t/year)	0.53	**DFEE**	47.03	**TFEE**	54.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.51		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.83 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.45 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.0 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 4.97 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.72 m², No overhang
Windows facing East: 5.06 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9700	
Infiltration rate			0.4425	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5218	0.5116	0.5014	0.4502	0.4400	0.3888	0.3888	0.3786	0.4093	0.4400	0.4604	0.4809	(22b)
Effective ac	0.6361	0.6309	0.6257	0.6013	0.5968	0.5756	0.5756	0.5717	0.5838	0.5968	0.6060	0.6156	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.2940	42.9342	42.5815	40.9250	40.6151	39.1723	39.1723	38.9051	39.7280	40.6151	41.2420	41.8975	(38)
Heat transfer coeff	99.1756	98.8158	98.4631	96.8066	96.4967	95.0539	95.0539	94.7867	95.6097	96.4967	97.1237	97.7792	(39)
Average = Sum(39)m / 12 =												96.8051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2431	1.2386	1.2342	1.2134	1.2095	1.1915	1.1915	1.1881	1.1984	1.2095	1.2174	1.2256	(40)
HLP (average)												1.2134	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	464.4736	548.4272	649.1701	761.8673	837.3320	829.3170	789.4436	722.3202	635.1359	528.0531	456.5376	437.2541	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7048	33.8275	33.9487	34.5296	34.6405	35.1663	35.1663	35.2654	34.9619	34.6405	34.4169	34.1862	
alpha	3.2470	3.2552	3.2632	3.3020	3.3094	3.3444	3.3444	3.3510	3.3308	3.3094	3.2945	3.2791	
util living area													
	0.9884	0.9793	0.9568	0.8998	0.7938	0.6398	0.4980	0.5540	0.7835	0.9396	0.9812	0.9904	(86)
MIT	18.9964	19.2342	19.6470	20.1806	20.6071	20.8681	20.9575	20.9392	20.7255	20.1434	19.4802	18.9663	(87)
Th 2	19.8857	19.8892	19.8928	19.9093	19.9124	19.9268	19.9268	19.9295	19.9213	19.9124	19.9061	19.8996	(88)
util rest of house													
	0.9858	0.9748	0.9472	0.8768	0.7464	0.5588	0.3891	0.4436	0.7160	0.9210	0.9764	0.9883	(89)
MIT 2	17.2191	17.5663	18.1635	18.9267	19.4982	19.8203	19.9043	19.8944	19.6687	18.8930	17.9369	17.1837	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.5863	17.9108	18.4700	19.1857	19.7272	20.0367	20.1219	20.1102	19.8870	19.1513	18.2557	17.5519	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4363	17.7608	18.3200	19.0357	19.5772	19.8867	19.9719	19.9602	19.7370	19.0013	18.1057	17.4019	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9621	0.9282	0.8538	0.7295	0.5555	0.3939	0.4470	0.7024	0.8998	0.9643	0.9808	(94)
Useful gains	453.8422	527.6262	602.5804	650.5078	610.8528	460.7045	310.9798	322.8954	446.1458	475.1567	440.2536	428.8652	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1302.7973	1270.8552	1163.8309	981.2061	760.1282	502.5244	320.5099	337.4637	538.9560	810.6937	1068.9106	1290.8725	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	631.6226	499.4499	417.5704	238.1028	111.0609	0.0000	0.0000	0.0000	0.0000	249.6395	452.6331	641.3334	(98)
Space heating												3241.4126	(98)
Space heating per m2											(98) / (4) =	40.6294	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3581.6714	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	631.6226	499.4499	417.5704	238.1028	111.0609	0.0000	0.0000	0.0000	0.0000	249.6395	452.6331	641.3334	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	697.9255	551.8783	461.4037	263.0970	122.7192	0.0000	0.0000	0.0000	0.0000	275.8448	500.1470	708.6557	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8176	89.7603	89.6301	89.3298	88.7578	87.3000	87.3000	87.3000	87.3000	89.3373	89.6886	89.8412	(217)
Fuel for water heating, kWh/month													
	183.8882	161.3644	167.7850	148.2361	144.2483	128.1956	120.4190	135.8687	136.8056	153.8422	165.3870	178.5222	(219)
Water heating fuel used												1824.5623	(219)
Annual totals kWh/year													
Space heating fuel - main system												3581.6714	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =											-1074.8994	-1074.8994	(233)
Total delivered energy for all uses												4763.2469	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3581.6714	0.2160	773.6410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5623	0.2160	394.1054	(264)
Space and water heating			1167.7465	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			834.0363	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.4500	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		28.9463	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.9463	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	464.4856	536.3195	620.7647	714.3935	775.8493	765.3921	729.1025	672.6332	599.5751	510.8194	453.1960	439.4627	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9983	0.9961	0.9886	0.9590	0.8731	0.7063	0.5388	0.6005	0.8561	0.9797	0.9965	0.9987	(86)
MIT	19.6935	19.8471	20.1210	20.4862	20.7849	20.9479	20.9891	20.9819	20.8584	20.4573	20.0123	19.6720	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9977	0.9948	0.9845	0.9433	0.8264	0.6143	0.4184	0.4769	0.7857	0.9692	0.9950	0.9982	(89)
MIT 2	18.1901	18.4163	18.8162	19.3456	19.7417	19.9295	19.9600	19.9587	19.8442	19.3151	18.6679	18.1665	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9925	0.9798	0.9363	0.8266	0.6310	0.4434	0.5024	0.7932	0.9637	0.9929	0.9973	(94)
Useful gains	462.8205	532.2798	608.2253	668.9029	641.3404	482.9731	323.2806	337.9245	475.5798	492.2513	449.9570	438.2566	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1344.3128	1303.5374	1184.2759	990.9332	763.9970	506.1960	326.4405	343.6765	546.6508	828.1996	1101.9511	1335.6629	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating												3312.8667	(98)
Space heating per m2											(98) / (4) =	41.5250	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3546.9665	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	702.1737	554.9091	458.8669	248.2460	97.7050	0.0000	0.0000	0.0000	0.0000	267.6077	502.6078	714.8504	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7995	87.5920	87.1036	85.9289	83.7191	80.3000	80.3000	80.3000	80.3000	85.9979	87.3182	87.8793	(217)
Fuel for water heating, kWh/month	230.0739	202.3931	211.7577	190.3861	189.1926	173.7253	166.4421	185.5439	187.5930	199.4590	209.6990	224.4415	(219)
Water heating fuel used												2370.7072	(219)
Annual totals kWh/year													
Space heating fuel - main system												3546.9665	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6349.5864	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3546.9665	0.2160	766.1448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.7072	0.2160	512.0728	(264)
Space and water heating			1278.2175	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1502.3802	(272)
Emissions per m2 for space and water heating			16.0218	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0218 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.9700	
Infiltration rate			0.3940	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3644	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4646	0.4555	0.4464	0.4009	0.3918	0.3462	0.3462	0.3371	0.3644	0.3918	0.4100	0.4282	(22b)
Effective ac	0.6079	0.6038	0.5996	0.5803	0.5767	0.5599	0.5599	0.5568	0.5664	0.5767	0.5840	0.5917	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3744	41.0891	40.8095	39.4962	39.2504	38.1066	38.1066	37.8947	38.5472	39.2504	39.7475	40.2672	(38)
Heat transfer coeff	97.2560	96.9708	96.6911	95.3778	95.1321	93.9882	93.9882	93.7764	94.4288	95.1321	95.6292	96.1489	(39)
Average = Sum(39)m / 12 =												95.3766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2191	1.2155	1.2120	1.1955	1.1924	1.1781	1.1781	1.1754	1.1836	1.1924	1.1987	1.2052	(40)
HLP (average)												1.1955	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	432.3673	517.0988	619.4567	734.3470	811.2364	805.2253	767.0523	697.7471	609.7854	500.4330	426.3545	405.9203	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3700	34.4712	34.5708	35.0469	35.1374	35.5650	35.5650	35.6454	35.3991	35.1374	34.9547	34.7658	
alpha	3.2913	3.2981	3.3047	3.3365	3.3425	3.3710	3.3710	3.3764	3.3599	3.3425	3.3303	3.3177	
util living area													
	0.9906	0.9824	0.9613	0.9063	0.8019	0.6489	0.5059	0.5652	0.7955	0.9466	0.9845	0.9923	(86)
MIT	18.9860	19.2246	19.6392	20.1722	20.6028	20.8655	20.9567	20.9370	20.7170	20.1255	19.4601	18.9506	(87)
Th 2	19.9048	19.9076	19.9104	19.9236	19.9261	19.9376	19.9376	19.9397	19.9331	19.9261	19.9211	19.9159	(88)
util rest of house													
	0.9885	0.9785	0.9526	0.8846	0.7557	0.5685	0.3968	0.4546	0.7300	0.9299	0.9804	0.9906	(89)
MIT 2	18.0687	18.3074	18.7183	19.2428	19.6386	19.8628	19.9218	19.9146	19.7535	19.2106	18.5530	18.0415	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2582	18.4969	18.9085	19.4348	19.8378	20.0699	20.1355	20.1258	19.9525	19.3996	18.7404	18.2293	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2582	18.4969	18.9085	19.4348	19.8378	20.0699	20.1355	20.1258	19.9525	19.3996	18.7404	18.2293	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9718	0.9422	0.8728	0.7514	0.5793	0.4182	0.4753	0.7314	0.9193	0.9743	0.9869	(94)
Useful gains	425.4951	502.4939	583.6629	640.9296	609.5603	466.4466	320.7737	331.6495	445.9796	460.0580	415.4180	400.6105	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1357.5153	1318.4985	1199.7920	1004.7814	774.1613	514.1084	332.2985	349.3914	552.6483	837.1252	1113.1584	1348.9026	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	693.4230	548.3551	458.4001	261.9734	122.4631	0.0000	0.0000	0.0000	0.0000	280.5380	502.3731	705.5293	(98)
Space heating												3573.0551	(98)
Space heating per m2											(98) / (4) =	44.7864	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.4891	695.5127	712.7005	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8275	0.8841	0.8545	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	731.0436	614.8757	608.9701	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1033.1059	986.6144	907.2322	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	217.4849	276.5736	221.9070	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												715.9655	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.3712	69.1434	55.4767	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												178.9914	(107)
Space cooling per m2												2.2436	(108)
Energy for space heating												44.7864	(99)
Energy for space cooling												2.2436	(108)
Total												47.0299	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	420.0002	492.9230	579.6054	676.0477	739.5525	731.7217	697.1254	637.8524	563.3892	471.7437	410.9391	395.7460	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9989	0.9973	0.9915	0.9666	0.8894	0.7293	0.5609	0.6280	0.8788	0.9853	0.9977	0.9992	(86)
MIT	19.6419	19.7972	20.0753	20.4491	20.7617	20.9398	20.9870	20.9779	20.8371	20.4154	19.9635	19.6210	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9985	0.9964	0.9883	0.9533	0.8461	0.6376	0.4369	0.5012	0.8142	0.9774	0.9967	0.9989	(89)
MIT 2	18.6908	18.8481	19.1268	19.5028	19.7904	19.9363	19.9607	19.9598	19.8661	19.4773	19.0252	18.6789	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9858	0.9493	0.8480	0.6548	0.4628	0.5276	0.8221	0.9745	0.9958	0.9985	(94)
Useful gains	419.1443	490.5901	571.3602	641.7939	627.1262	479.1676	322.6256	336.5415	463.1510	459.7196	409.2036	395.1474	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1380.9137	1334.8978	1206.5707	1001.7884	767.1336	506.5306	326.4500	343.6823	547.8447	839.3066	1127.3915	1372.7109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	715.5564	567.3748	472.5966	259.1960	104.1655	0.0000	0.0000	0.0000	0.0000	282.4127	517.0953	727.3073	(98)
Space heating												3645.7045	(98)
Space heating per m2											(98) / (4) =	45.6970	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8725	0.9298	0.9028	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	749.3878	628.6644	625.4848	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	947.1926	904.8817	837.2253	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	142.4195	205.5057	157.5349	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												505.4600	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	35.6049	51.3764	39.3837	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.3650 (107)
Space cooling per m2												1.5839 (108)
Energy for space heating												45.6970 (99)
Energy for space cooling												1.5839 (108)
Total												47.2809 (109)
Target Fabric Energy Efficiency (TFEE)												54.4 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9700	
Infiltration rate			0.4425	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4297	0.3990	0.4093	0.3888	0.3888	0.3786	0.3683	0.3581	0.3479	0.3786	0.3581	0.3786	(22b)
Effective ac	0.5923	0.5796	0.5838	0.5756	0.5756	0.5717	0.5678	0.5641	0.5605	0.5717	0.5641	0.5717	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3123	39.4466	39.7280	39.1723	39.1723	38.9051	38.6451	38.3921	38.1463	38.9051	38.3921	38.9051	(38)
Heat transfer coeff	96.1939	95.3282	95.6097	95.0539	95.0539	94.7867	94.5267	94.2738	94.0279	94.7867	94.2738	94.7867	(39)
Average = Sum(39)m / 12 =												94.8918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2057	1.1949	1.1984	1.1915	1.1915	1.1881	1.1848	1.1817	1.1786	1.1881	1.1817	1.1881	(40)
HLP (average)												1.1894	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	13.4839	0.4600	0.0000	0.7700	3.4387	(74)
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	115.6033	192.2997	318.8331	467.4602	544.6342	605.9078	572.1935	503.3912	391.4669	246.0631	143.6392	93.4752	(83)
Total gains	669.5957	741.8896	847.0426	962.5568	1005.8571	1036.7959	985.3662	924.8451	831.9902	719.9108	654.5037	632.3172	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7495	35.0651	34.9619	35.1663	35.1663	35.2654	35.3624	35.4573	35.5500	35.2654	35.4573	35.2654	
alpha	3.3166	3.3377	3.3308	3.3444	3.3444	3.3510	3.3575	3.3638	3.3700	3.3510	3.3638	3.3510	
util living area	0.9639	0.9491	0.9072	0.8161	0.6795	0.4913	0.3654	0.3866	0.6276	0.8510	0.9408	0.9682	(86)
MIT	19.4734	19.6569	20.0348	20.4783	20.7889	20.9475	20.9854	20.9828	20.8805	20.4952	19.9469	19.4646	(87)
Th 2	19.9154	19.9241	19.9213	19.9268	19.9268	19.9295	19.9321	19.9347	19.9372	19.9295	19.9347	19.9295	(88)
util rest of house	0.9565	0.9391	0.8889	0.7809	0.6203	0.4092	0.2692	0.2858	0.5460	0.8127	0.9269	0.9617	(89)
MIT 2	17.9256	18.1930	18.7248	19.3320	19.7230	19.8934	19.9260	19.9274	19.8420	19.3739	18.6197	17.9227	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2453	18.4954	18.9954	19.5688	19.9432	20.1111	20.1448	20.1454	20.0565	19.6055	18.8939	18.2412	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0953	18.3454	18.8454	19.4188	19.7932	19.9611	19.9948	19.9954	19.9065	19.4555	18.7439	18.0912	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9195	0.8662	0.7618	0.6122	0.4118	0.2750	0.2917	0.5434	0.7923	0.9063	0.9459	(94)
Useful gains	629.1054	682.1600	733.6681	733.2593	615.8332	426.9060	270.9522	269.7715	452.1336	570.3797	593.2077	598.1110	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.3106	1243.5924	1132.5329	942.8231	693.2487	441.8131	273.6398	272.9600	489.5570	763.5581	1022.2928	1240.8705	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	476.3126	377.2825	296.7554	150.8859	57.5971	0.0000	0.0000	0.0000	0.0000	143.7247	308.9413	478.2131	(98)

Space heating 2289.7127 (98)
RHI space heating demand 2290 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9700	
Infiltration rate		0.4425	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5218	0.5116	0.5014	0.4502	0.4400	0.3888	0.3888	0.3786	0.4093	0.4400	0.4604	0.4809	(22b)
Effective ac	0.6361	0.6309	0.6257	0.6013	0.5968	0.5756	0.5756	0.5717	0.5838	0.5968	0.6060	0.6156	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.2940	42.9342	42.5815	40.9250	40.6151	39.1723	39.1723	38.9051	39.7280	40.6151	41.2420	41.8975	(38)
Heat transfer coeff	99.1756	98.8158	98.4631	96.8066	96.4967	95.0539	95.0539	94.7867	95.6097	96.4967	97.1237	97.7792	(39)
Average = Sum(39)m / 12 =												96.8051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2431	1.2386	1.2342	1.2134	1.2095	1.1915	1.1915	1.1881	1.1984	1.2095	1.2174	1.2256	(40)
HLP (average)												1.2134	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7048	33.8275	33.9487	34.5296	34.6405	35.1663	35.1663	35.2654	34.9619	34.6405	34.4169	34.1862	
alpha	3.2470	3.2552	3.2632	3.3020	3.3094	3.3444	3.3444	3.3510	3.3308	3.3094	3.2945	3.2791	
util living area													
	0.9710	0.9562	0.9234	0.8504	0.7315	0.5721	0.4350	0.4808	0.7017	0.8896	0.9562	0.9749	(86)
MIT	19.2749	19.4972	19.8732	20.3441	20.6999	20.9062	20.9716	20.9602	20.8083	20.3315	19.7296	19.2430	(87)
Th 2	19.8857	19.8892	19.8928	19.9093	19.9124	19.9268	19.9268	19.9295	19.9213	19.9124	19.9061	19.8996	(88)
util rest of house													
	0.9651	0.9474	0.9079	0.8205	0.6792	0.4932	0.3363	0.3796	0.6278	0.8604	0.9460	0.9698	(89)
MIT 2	17.6207	17.9420	18.4791	19.1414	19.6051	19.8535	19.9123	19.9076	19.7534	19.1435	18.2918	17.5835	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9624	18.2632	18.7671	19.3898	19.8312	20.0710	20.1312	20.1250	19.9713	19.3889	18.5888	17.9263	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8124	18.1132	18.6171	19.2398	19.6812	19.9210	19.9812	19.9750	19.8213	19.2389	18.4388	17.7763	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9284	0.8851	0.7988	0.6668	0.4928	0.3415	0.3841	0.6202	0.8379	0.9271	0.9557	(94)
Useful gains	611.7006	673.8914	724.6527	734.9501	656.0420	476.3885	315.1775	329.5869	482.9432	572.2710	577.8360	585.8280	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1340.1003	1305.6746	1193.0848	1000.9646	770.1619	505.7802	321.3917	338.8632	547.0153	833.6252	1101.2656	1327.4768	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	541.9294	424.5583	348.5135	191.5304	84.9052	0.0000	0.0000	0.0000	0.0000	194.4476	376.8693	551.7867	(98)
Space heating												2714.5403	(98)
Space heating per m2											(98) / (4) =	34.0253	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2999.4921	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	541.9294	424.5583	348.5135	191.5304	84.9052	0.0000	0.0000	0.0000	0.0000	194.4476	376.8693	551.7867	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	598.8170	469.1252	385.0978	211.6358	93.8179	0.0000	0.0000	0.0000	0.0000	214.8592	416.4302	609.7090	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7317	89.6640	89.5110	89.1640	88.5484	87.3000	87.3000	87.3000	87.3000	89.1468	89.5727	89.7590	(217)
Fuel for water heating, kWh/month													
	184.0641	161.5379	168.0083	148.5116	144.5894	128.1956	120.4190	135.8687	136.8056	154.1709	165.6009	178.6856	(219)
Water heating fuel used												1826.4575	(219)
Annual totals kWh/year													
Space heating fuel - main system												2999.4921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4182.9629	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2999.4921	3.4800	104.3823	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4575	3.4800	63.5607	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			203.1331	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6837	(257)
SAP value		90.4620	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2999.4921	0.2160	647.8903	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4575	0.2160	394.5148	(264)
Space and water heating			1042.4051	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			708.6950	(272)
CO2 emissions per m2			8.8800	(273)
EI value			92.3894	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9700	
Infiltration rate		0.4425	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4297	0.3990	0.4093	0.3888	0.3888	0.3786	0.3683	0.3581	0.3479	0.3786	0.3581	0.3786	(22b)
Effective ac	0.5923	0.5796	0.5838	0.5756	0.5756	0.5717	0.5678	0.5641	0.5605	0.5717	0.5641	0.5717	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3123	39.4466	39.7280	39.1723	39.1723	38.9051	38.6451	38.3921	38.1463	38.9051	38.3921	38.9051	(38)
Heat transfer coeff	96.1939	95.3282	95.6097	95.0539	95.0539	94.7867	94.5267	94.2738	94.0279	94.7867	94.2738	94.7867	(39)
Average = Sum(39)m / 12 =												94.8918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2057	1.1949	1.1984	1.1915	1.1915	1.1881	1.1848	1.1817	1.1786	1.1881	1.1817	1.1881	(40)
HLP (average)												1.1894	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	13.4839	0.4600	0.0000	0.7700	3.4387	(74)
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	115.6033	192.2997	318.8331	467.4602	544.6342	605.9078	572.1935	503.3912	391.4669	246.0631	143.6392	93.4752	(83)
Total gains	669.5957	741.8896	847.0426	962.5568	1005.8571	1036.7959	985.3662	924.8451	831.9902	719.9108	654.5037	632.3172	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7495	35.0651	34.9619	35.1663	35.1663	35.2654	35.3624	35.4573	35.5500	35.2654	35.4573	35.2654	
alpha	3.3166	3.3377	3.3308	3.3444	3.3444	3.3510	3.3575	3.3638	3.3700	3.3510	3.3638	3.3510	
util living area													
	0.9639	0.9491	0.9072	0.8161	0.6795	0.4913	0.3654	0.3866	0.6276	0.8510	0.9408	0.9682	(86)
MIT	19.4734	19.6569	20.0348	20.4783	20.7889	20.9475	20.9854	20.9828	20.8805	20.4952	19.9469	19.4646	(87)
Th 2	19.9154	19.9241	19.9213	19.9268	19.9268	19.9295	19.9321	19.9347	19.9372	19.9295	19.9347	19.9295	(88)
util rest of house													
	0.9565	0.9391	0.8889	0.7809	0.6203	0.4092	0.2692	0.2858	0.5460	0.8127	0.9269	0.9617	(89)
MIT 2	17.9256	18.1930	18.7248	19.3320	19.7230	19.8934	19.9260	19.9274	19.8420	19.3739	18.6197	17.9227	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2453	18.4954	18.9954	19.5688	19.9432	20.1111	20.1448	20.1454	20.0565	19.6055	18.8939	18.2412	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0953	18.3454	18.8454	19.4188	19.7932	19.9611	19.9948	19.9954	19.9065	19.4555	18.7439	18.0912	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9195	0.8662	0.7618	0.6122	0.4118	0.2750	0.2917	0.5434	0.7923	0.9063	0.9459	(94)
Useful gains	629.1054	682.1600	733.6681	733.2593	615.8332	426.9060	270.9522	269.7715	452.1336	570.3797	593.2077	598.1110	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1269.3106	1243.5924	1132.5329	942.8231	693.2487	441.8131	273.6398	272.9600	489.5570	763.5581	1022.2928	1240.8705	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	476.3126	377.2825	296.7554	150.8859	57.5971	0.0000	0.0000	0.0000	0.0000	143.7247	308.9413	478.2131	(98)
Space heating												2289.7127	(98)
Space heating per m2											(98) / (4) =	28.7003	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2530.0693	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	476.3126	377.2825	296.7554	150.8859	57.5971	0.0000	0.0000	0.0000	0.0000	143.7247	308.9413	478.2131	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	526.3123	416.8868	327.9066	166.7248	63.6432	0.0000	0.0000	0.0000	0.0000	158.8118	341.3716	528.4123	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6539	89.5890	89.3979	88.9756	88.2684	87.3000	87.3000	87.3000	87.3000	88.9070	89.4366	89.6744	(217)
Fuel for water heating, kWh/month													
	184.2240	161.6730	168.2208	148.8262	145.0481	128.1956	120.4190	135.8687	136.8056	154.5868	165.8530	178.8542	(219)
Water heating fuel used												1828.5747	(219)
Annual totals kWh/year													
Space heating fuel - main system												2530.0693	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3569.8320	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2530.0693	9.7400	246.4287	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.5747	9.7400	178.1032	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			237.8547	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2530.0693	0.2160	546.4950	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5747	0.2160	394.9721	(264)
Space and water heating			941.4671	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			532.0737	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2530.0693	1.2200	3086.6845	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5747	1.2200	2230.8612	(264)
Space and water heating			5317.5457	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2895.8928	(272)
Primary energy kWh/m2/year			36.2985	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: A 92

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (34.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.32 kg/m²	A 92	A 94
Total Savings	£77	2.32 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£178	-£18
Mains gas	£529	£433	£95
Space heating	£378	£378	£0
Water heating	£178	£101	£77
Lighting	£132	£132	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£238	£161	£77
Total cost of uses	£238	£161	£77
Delivered energy	45 kWh/m²	33 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	36 kWh/m²	23 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9700	
Infiltration rate		0.4425	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5218	0.5116	0.5014	0.4502	0.4400	0.3888	0.3888	0.3786	0.4093	0.4400	0.4604	0.4809	(22b)
Effective ac	0.6361	0.6309	0.6257	0.6013	0.5968	0.5756	0.5756	0.5717	0.5838	0.5968	0.6060	0.6156	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.2940	42.9342	42.5815	40.9250	40.6151	39.1723	39.1723	38.9051	39.7280	40.6151	41.2420	41.8975	(38)
Heat transfer coeff	99.1756	98.8158	98.4631	96.8066	96.4967	95.0539	95.0539	94.7867	95.6097	96.4967	97.1237	97.7792	(39)
Average = Sum(39)m / 12 =												96.8051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2431	1.2386	1.2342	1.2134	1.2095	1.1915	1.1915	1.1881	1.1984	1.2095	1.2174	1.2256	(40)
HLP (average)												1.2134	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                          Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1079.5246 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1813.6014 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.2449 (H8)
Utilisation factor                                                                                                                  0.5521 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -843.3953 (H17)
Solar input    -24.4568   -40.8113   -69.5064   -93.1523  -115.0818  -113.1437  -111.6485   -97.5478   -76.3995   -52.1719   -29.0093   -20.4662 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -843.3953 (63)
Output from w/h
              140.7071   104.0299    80.8795    39.2667    12.9499     0.0000     0.0000    21.0655    43.0318    85.2666   119.3239   139.9203 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =      786.4412 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
North                                  0.7200            10.6334            0.4600           0.0000           0.7700            2.7118 (74)
East                                   5.0600            19.6403            0.4600           0.0000           0.7700           35.2003 (76)
West                                   3.0000            19.6403            0.4600           0.0000           0.7700           20.8697 (80)
West                                   4.5100            19.6403            0.4600           0.0000           0.7700           31.3742 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains    90.1560   176.2418   290.5166   425.0028   522.5763   535.8425   509.7684   436.6339   338.2288   209.1454   112.3780    74.1705 (83)
Total gains   644.1484   725.8317   818.7261   920.0994   983.7992   966.7307   922.9410   858.0878   778.7521   682.9930   623.2425   613.0125 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           33.7048    33.8275    33.9487    34.5296    34.6405    35.1663    35.1663    35.2654    34.9619    34.6405    34.4169    34.1862
alpha          3.2470     3.2552     3.2632     3.3020     3.3094     3.3444     3.3444     3.3510     3.3308     3.3094     3.2945     3.2791
util living area
               0.9710     0.9562     0.9234     0.8504     0.7315     0.5721     0.4350     0.4808     0.7017     0.8896     0.9562     0.9749 (86)

MIT           19.2749    19.4972    19.8732    20.3441    20.6999    20.9062    20.9716    20.9602    20.8083    20.3315    19.7296    19.2430 (87)
Th 2          19.8857    19.8892    19.8928    19.9093    19.9124    19.9268    19.9268    19.9295    19.9213    19.9124    19.9061    19.8996 (88)
util rest of house
               0.9651     0.9474     0.9079     0.8205     0.6792     0.4932     0.3363     0.3796     0.6278     0.8604     0.9460     0.9698 (89)
MIT 2         17.6207    17.9420    18.4791    19.1414    19.6051    19.8535    19.9123    19.9076    19.7534    19.1435    18.2918    17.5835 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           17.9624    18.2632    18.7671    19.3898    19.8312    20.0710    20.1312    20.1250    19.9713    19.3889    18.5888    17.9263 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.8124    18.1132    18.6171    19.2398    19.6812    19.9210    19.9812    19.9750    19.8213    19.2389    18.4388    17.7763 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9284	0.8851	0.7988	0.6668	0.4928	0.3415	0.3841	0.6202	0.8379	0.9271	0.9557	(94)
Useful gains	611.7006	673.8914	724.6527	734.9501	656.0420	476.3885	315.1775	329.5869	482.9432	572.2710	577.8360	585.8280	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1340.1003	1305.6746	1193.0848	1000.9646	770.1619	505.7802	321.3917	338.8632	547.0153	833.6252	1101.2656	1327.4768	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	541.9294	424.5583	348.5135	191.5304	84.9052	0.0000	0.0000	0.0000	0.0000	194.4476	376.8693	551.7867	(98)
Space heating												2714.5403	(98)
Space heating per m2											(98) / (4) =	34.0253	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2999.4921	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	541.9294	424.5583	348.5135	191.5304	84.9052	0.0000	0.0000	0.0000	0.0000	194.4476	376.8693	551.7867	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	598.8170	469.1252	385.0978	211.6358	93.8179	0.0000	0.0000	0.0000	0.0000	214.8592	416.4302	609.7090	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8214	89.8518	89.8794	89.9391	90.0631	87.3000	87.3000	87.3000	87.3000	89.4999	89.7092	89.8339	(217)
Fuel for water heating, kWh/month	156.6522	115.7794	89.9866	43.6592	14.3786	0.0000	0.0000	24.1300	49.2919	95.2700	133.0119	155.7545	(219)
Water heating fuel used												877.9143	(219)
Annual totals kWh/year													
Space heating fuel - main system												2999.4921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3284.4196	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2999.4921	3.4800	104.3823	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9143	3.4800	30.5514	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			176.7188	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5948	(257)
SAP value	91.7022	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2999.4921	0.2160	647.8903	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9143	0.2160	189.6295	(264)
Space and water heating			837.5198	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			529.7596	(272)
CO2 emissions per m2			6.6400	(273)
EI value			94.3110	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9700	
Infiltration rate		0.4425	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4297	0.3990	0.4093	0.3888	0.3888	0.3786	0.3683	0.3581	0.3479	0.3786	0.3581	0.3786	(22b)
Effective ac	0.5923	0.5796	0.5838	0.5756	0.5756	0.5717	0.5678	0.5641	0.5605	0.5717	0.5641	0.5717	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3123	39.4466	39.7280	39.1723	39.1723	38.9051	38.6451	38.3921	38.1463	38.9051	38.3921	38.9051	(38)
Heat transfer coeff	96.1939	95.3282	95.6097	95.0539	95.0539	94.7867	94.5267	94.2738	94.0279	94.7867	94.2738	94.7867	(39)
Average = Sum(39)m / 12 =												94.8918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2057	1.1949	1.1984	1.1915	1.1915	1.1881	1.1848	1.1817	1.1786	1.1881	1.1817	1.1881	(40)
HLP (average)												1.1894	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	13.4839	0.4600	0.0000	0.7700	3.4387	(74)
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	115.6033	192.2997	318.8331	467.4602	544.6342	605.9078	572.1935	503.3912	391.4669	246.0631	143.6392	93.4752	(83)
Total gains	669.5957	741.8896	847.0426	962.5568	1005.8571	1036.7959	985.3662	924.8451	831.9902	719.9108	654.5037	632.3172	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7495	35.0651	34.9619	35.1663	35.1663	35.2654	35.3624	35.4573	35.5500	35.2654	35.4573	35.2654	
alpha	3.3166	3.3377	3.3308	3.3444	3.3444	3.3510	3.3575	3.3638	3.3700	3.3510	3.3638	3.3510	
util living area													
	0.9639	0.9491	0.9072	0.8161	0.6795	0.4913	0.3654	0.3866	0.6276	0.8510	0.9408	0.9682	(86)
MIT	19.4734	19.6569	20.0348	20.4783	20.7889	20.9475	20.9854	20.9828	20.8805	20.4952	19.9469	19.4646	(87)
Th 2	19.9154	19.9241	19.9213	19.9268	19.9268	19.9295	19.9321	19.9347	19.9372	19.9295	19.9347	19.9295	(88)
util rest of house													
	0.9565	0.9391	0.8889	0.7809	0.6203	0.4092	0.2692	0.2858	0.5460	0.8127	0.9269	0.9617	(89)
MIT 2	17.9256	18.1930	18.7248	19.3320	19.7230	19.8934	19.9260	19.9274	19.8420	19.3739	18.6197	17.9227	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2453	18.4954	18.9954	19.5688	19.9432	20.1111	20.1448	20.1454	20.0565	19.6055	18.8939	18.2412	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0953	18.3454	18.8454	19.4188	19.7932	19.9611	19.9948	19.9954	19.9065	19.4555	18.7439	18.0912	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9195	0.8662	0.7618	0.6122	0.4118	0.2750	0.2917	0.5434	0.7923	0.9063	0.9459	(94)
Useful gains	629.1054	682.1600	733.6681	733.2593	615.8332	426.9060	270.9522	269.7715	452.1336	570.3797	593.2077	598.1110	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.3106	1243.5924	1132.5329	942.8231	693.2487	441.8131	273.6398	272.9600	489.5570	763.5581	1022.2928	1240.8705	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	476.3126	377.2825	296.7554	150.8859	57.5971	0.0000	0.0000	0.0000	0.0000	143.7247	308.9413	478.2131	(98)
Space heating												2289.7127	(98)
Space heating per m2											(98) / (4) =	28.7003	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2530.0693	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	476.3126	377.2825	296.7554	150.8859	57.5971	0.0000	0.0000	0.0000	0.0000	143.7247	308.9413	478.2131	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	526.3123	416.8868	327.9066	166.7248	63.6432	0.0000	0.0000	0.0000	0.0000	158.8118	341.3716	528.4123	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7667	89.7876	89.7971	89.8342	89.7365	87.3000	87.3000	87.3000	87.3000	89.3163	89.6115	89.7677	(217)
Fuel for water heating, kWh/month	152.1746	116.0829	89.7374	42.5637	19.4001	0.0000	0.0000	17.2721	43.9527	91.1322	127.8318	152.5051	(219)
Water heating fuel used												852.6526	(219)

Annual totals kWh/year		
Space heating fuel - main system	2530.0693	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =	-1220.7247	(233)
Total delivered energy for all uses	2643.9098	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2530.0693	9.7400	246.4287	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.6526	9.7400	83.0484	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			161.2249	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2530.0693	0.2160	546.4950	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6526	0.2160	184.1730	(264)
Space and water heating			730.6679	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			347.2245	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2530.0693	1.2200	3086.6845	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6526	1.2200	1040.2361	(264)
Space and water heating			4126.9207	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1858.7678	(272)
Primary energy kWh/m2/year			23.2987	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.7200	81.1852	0.4600	0.0000	0.9000	24.1997
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						635.7041

	Jun	Jul	Aug	
Solar gains	675	636	558	(P4)
Internal gains	428	410	418	
Total summer gains	1103	1046	976	(P5)
Summer gain/loss ratio	3.36	3.19	2.97	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.31	22.03	21.72	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-350	**Issued on Date**	31/05/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	6, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.30	**TER**	18.71
Environmental	93 A	**% DER<TER**	44.94		
CO_2 Emissions (t/year)	0.52	**DFEE**	46.36	**TFEE**	53.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.75		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.71 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.30 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.81 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 5.06 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value: 0.00 W/m²K
Floor U-value: 0.12 W/m²K
Thermal bridging y-value: 0.037 W/m²K
Photovoltaic array: 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8100	
Infiltration rate		0.4345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5124	0.5023	0.4923	0.4421	0.4320	0.3818	0.3818	0.3717	0.4019	0.4320	0.4521	0.4722	(22b)
Effective ac	0.6313	0.6262	0.6212	0.5977	0.5933	0.5729	0.5729	0.5691	0.5808	0.5933	0.6022	0.6115	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.9620	42.6150	42.2750	40.6778	40.3790	38.9879	38.9879	38.7303	39.5238	40.3790	40.9835	41.6155	(38)
Heat transfer coeff	98.8436	98.4967	98.1566	96.5595	96.2607	94.8696	94.8696	94.6120	95.4054	96.2607	96.8652	97.4972	(39)
Average = Sum(39)m / 12 =												96.5580	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2390	1.2346	1.2303	1.2103	1.2066	1.1891	1.1891	1.1859	1.1959	1.2066	1.2142	1.2221	(40)
HLP (average)												1.2103	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	473.6848	562.7715	665.2376	775.8349	847.5725	837.1112	797.9449	733.9616	650.5315	542.9455	467.3250	445.2959	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8180	33.9371	34.0547	34.6180	34.7254	35.2346	35.2346	35.3306	35.0367	34.7254	34.5087	34.2850	
alpha	3.2545	3.2625	3.2703	3.3079	3.3150	3.3490	3.3490	3.3554	3.3358	3.3150	3.3006	3.2857	
util living area													
	0.9877	0.9778	0.9539	0.8953	0.7888	0.6350	0.4928	0.5464	0.7739	0.9352	0.9799	0.9899	(86)
MIT	19.0183	19.2631	19.6757	20.2004	20.6170	20.8717	20.9590	20.9419	20.7376	20.1664	19.5018	18.9855	(87)
Th 2	19.8890	19.8924	19.8958	19.9118	19.9147	19.9287	19.9287	19.9313	19.9233	19.9147	19.9087	19.9024	(88)
util rest of house													
	0.9850	0.9730	0.9437	0.8717	0.7409	0.5542	0.3848	0.4369	0.7054	0.9155	0.9748	0.9877	(89)
MIT 2	17.2528	17.6098	18.2060	18.9550	19.5119	19.8252	19.9070	19.8979	19.6834	18.9260	17.9695	17.2131	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6175	17.9513	18.5096	19.2122	19.7402	20.0414	20.1243	20.1136	19.9011	19.1822	18.2860	17.5792	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4675	17.8013	18.3596	19.0622	19.5902	19.8914	19.9743	19.9636	19.7511	19.0322	18.1360	17.4292	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9597	0.9243	0.8488	0.7245	0.5511	0.3897	0.4405	0.6926	0.8940	0.9623	0.9799	(94)
Useful gains	462.3007	540.0741	614.8876	658.5059	614.0513	461.3402	310.9494	323.2866	450.5734	485.3932	449.6869	436.3478	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1301.5214	1270.7399	1164.0970	981.2611	759.5179	501.9914	320.1215	337.1565	539.1494	811.6893	1069.0071	1289.8124	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.3802	491.0074	408.6118	232.3837	108.2272	0.0000	0.0000	0.0000	0.0000	242.7643	445.9105	634.9776	(98)
Space heating												3188.2628	(98)
Space heating per m2											(98) / (4) =	39.9632	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3522.9423	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.3802	491.0074	408.6118	232.3837	108.2272	0.0000	0.0000	0.0000	0.0000	242.7643	445.9105	634.9776	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	689.9229	542.5497	451.5048	256.7776	119.5880	0.0000	0.0000	0.0000	0.0000	268.2479	492.7188	701.6328	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8113	89.7506	89.6163	89.3117	88.7373	87.3000	87.3000	87.3000	87.3000	89.3165	89.6795	89.8360	(217)
Fuel for water heating, kWh/month													
	183.9009	161.3819	167.8109	148.2661	144.2816	128.1956	120.4190	135.8687	136.8056	153.8780	165.4038	178.5326	(219)
Water heating fuel used												1824.7446	(219)
Annual totals kWh/year													
Space heating fuel - main system												3522.9423	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4704.7002	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3522.9423	0.2160	760.9555	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.7446	0.2160	394.1448	(264)
Space and water heating			1155.1004	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			821.3902	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.3000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.3000	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		28.7963	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7963	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	472.4332	548.6961	634.6280	726.4452	784.6852	772.1171	736.4376	682.6777	612.8588	523.6690	462.5036	446.4014	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9957	0.9875	0.9564	0.8690	0.7017	0.5339	0.5929	0.8475	0.9776	0.9961	0.9986	(86)
MIT	19.7027	19.8613	20.1362	20.4976	20.7902	20.9494	20.9896	20.9828	20.8656	20.4708	20.0230	19.6801	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9942	0.9830	0.9399	0.8215	0.6097	0.4144	0.4703	0.7753	0.9662	0.9945	0.9981	(89)
MIT 2	18.2035	18.4369	18.8381	19.3610	19.7477	19.9306	19.9602	19.9592	19.8512	19.3338	18.6834	18.1783	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9918	0.9781	0.9329	0.8221	0.6266	0.4392	0.4956	0.7835	0.9604	0.9922	0.9971	(94)
Useful gains	470.6160	544.1708	620.7324	677.7332	645.0818	483.7864	323.4325	338.3126	480.1711	502.9476	458.9157	445.0921	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.5016	1305.3554	1186.2018	992.2814	764.5404	506.3037	326.4608	343.7277	547.2975	829.8296	1103.3045	1336.6943	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating												3269.0044	(98)
Space heating per m2											(98) / (4) =	40.9752	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3500.0047	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	696.9110	547.6618	450.4382	242.4783	95.1577	0.0000	0.0000	0.0000	0.0000	260.3857	496.7451	710.2270	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7850	87.5653	87.0623	85.8702	83.6596	80.3000	80.3000	80.3000	80.3000	85.9298	87.2930	87.8671	(217)
Fuel for water heating, kWh/month													
	230.1120	202.4549	211.8581	190.5162	189.3271	173.7253	166.4421	185.5439	187.5930	199.6169	209.7595	224.4729	(219)
Water heating fuel used												2371.4221	(219)
Annual totals kWh/year													
Space heating fuel - main system												3500.0047	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6303.3394	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3500.0047	0.2160	756.0010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.4221	0.2160	512.2272	(264)
Space and water heating			1268.2282	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1492.3908	(272)
Emissions per m2 for space and water heating			15.8966	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8966 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.7100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.8100	
Infiltration rate			0.3860	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3570	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4552	0.4463	0.4373	0.3927	0.3838	0.3392	0.3392	0.3302	0.3570	0.3838	0.4016	0.4195	(22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5807	0.5880	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.0791	40.8053	40.5369	39.2764	39.0405	37.9426	37.9426	37.7393	38.3655	39.0405	39.5176	40.0164	(38)
Heat transfer coeff	96.9607	96.6869	96.4185	95.1580	94.9221	93.8243	93.8243	93.6209	94.2471	94.9221	95.3993	95.8980	(39)
Average = Sum(39)m / 12 =												95.1569	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2154	1.2119	1.2086	1.1928	1.1898	1.1760	1.1760	1.1735	1.1813	1.1898	1.1958	1.2020	(40)
HLP (average)												1.1927	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	441.5784	531.4431	635.5241	748.3146	821.4770	813.0195	775.5536	709.3885	625.1809	515.3254	437.1418	413.9621	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4747	34.5723	34.6686	35.1278	35.2151	35.6272	35.6272	35.7045	35.4673	35.2151	35.0390	34.8567	
alpha	3.2983	3.3048	3.3112	3.3419	3.3477	3.3751	3.3751	3.3803	3.3645	3.3477	3.3359	3.3238	
util living area													
	0.9900	0.9809	0.9585	0.9020	0.7969	0.6440	0.5007	0.5574	0.7858	0.9423	0.9833	0.9919	(86)
MIT	19.0073	19.2531	19.6678	20.1921	20.6128	20.8691	20.9582	20.9399	20.7295	20.1488	19.4815	18.9693	(87)
Th 2	19.9077	19.9105	19.9132	19.9258	19.9282	19.9392	19.9392	19.9413	19.9350	19.9282	19.9234	19.9184	(88)
util rest of house													
	0.9878	0.9768	0.9492	0.8795	0.7502	0.5637	0.3925	0.4476	0.7192	0.9246	0.9790	0.9901	(89)
MIT 2	18.0919	18.3376	18.7479	19.2627	19.6485	19.8666	19.9240	19.9174	19.7644	19.2341	18.5757	18.0618	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2810	18.5267	18.9380	19.4547	19.8477	20.0737	20.1376	20.1286	19.9637	19.4230	18.7628	18.2493	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2810	18.5267	18.9380	19.4547	19.8477	20.0737	20.1376	20.1286	19.9637	19.4230	18.7628	18.2493	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9697	0.9386	0.8678	0.7463	0.5747	0.4137	0.4683	0.7212	0.9139	0.9726	0.9862	(94)
Useful gains	434.1542	515.3414	596.5133	649.3987	613.0275	467.2253	320.8207	332.1879	450.9107	470.9442	425.1733	408.2508	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1355.6103	1317.5270	1199.2488	1004.3647	773.4000	513.5647	331.9163	349.0768	552.6403	837.5020	1112.6251	1347.2987	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.5633	539.0687	448.4353	255.5755	119.3171	0.0000	0.0000	0.0000	0.0000	272.7191	494.9652	698.6517	(98)
Space heating												3514.2959	(98)
Space heating per m2											(98) / (4) =	44.0498	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	881.9480	694.2995	711.5191	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8311	0.8872	0.8595	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	733.0233	616.0084	611.5782	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1042.2160	996.5510	920.8390	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	222.6187	283.1237	230.0901	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												735.8325	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.6547	70.7809	57.5225	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												183.9581	(107)
Space cooling per m2												2.3058	(108)
Energy for space heating												44.0498	(99)
Energy for space cooling												2.3058	(108)
Total												46.3557	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	427.9478	505.2996	593.4688	688.0993	748.3884	738.4467	704.4605	647.8968	576.6729	484.5933	420.2468	402.6847	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9970	0.9906	0.9643	0.8855	0.7247	0.5557	0.6199	0.8706	0.9836	0.9975	0.9991	(86)
MIT	19.6511	19.8115	20.0908	20.4609	20.7676	20.9415	20.9876	20.9791	20.8452	20.4293	19.9743	19.6291	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9960	0.9871	0.9503	0.8414	0.6329	0.4326	0.4940	0.8037	0.9749	0.9964	0.9988	(89)
MIT 2	18.7000	18.8623	19.1420	19.5138	19.7950	19.9372	19.9609	19.9602	19.8718	19.4906	19.0360	18.6870	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9844	0.9463	0.8435	0.6502	0.4582	0.5202	0.8123	0.9719	0.9954	0.9984	(94)
Useful gains	427.0023	502.6483	584.2200	651.1352	631.2473	480.1137	322.8104	337.0254	468.4464	470.9619	418.2956	402.0272	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7863	1336.2379	1208.0068	1002.8277	767.5815	506.6286	326.4703	343.7342	548.4112	840.5503	1128.3900	1373.4673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.3593	560.1722	464.0973	253.2186	101.4326	0.0000	0.0000	0.0000	0.0000	274.9738	511.2679	722.7515	(98)
Space heating												3598.2733	(98)
Space heating per m2											(98) / (4) =	45.1024	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8754	0.9319	0.9069	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	751.9115	630.1425	628.3249	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	955.0530	913.4552	848.9656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.2619	210.7847	164.1567	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												521.2033	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   36.5655   52.6962   41.0392    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        130.3008 (107)
Space cooling per m2                                                                                                   1.6333 (108)
Energy for space heating                                                                                              45.1024 (99)
Energy for space cooling                                                                                               1.6333 (108)
Total                                                                                                                 46.7357 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   53.7 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8100	
Infiltration rate			0.4345	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4220	0.3918	0.4019	0.3818	0.3818	0.3717	0.3617	0.3516	0.3416	0.3717	0.3516	0.3717	(22b)
Effective ac	0.5890	0.5768	0.5808	0.5729	0.5729	0.5691	0.5654	0.5618	0.5583	0.5691	0.5618	0.5691	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0871	39.2524	39.5238	38.9879	38.9879	38.7303	38.4796	38.2357	37.9987	38.7303	38.2357	38.7303	(38)
Heat transfer coeff	95.9687	95.1341	95.4054	94.8696	94.8696	94.6120	94.3612	94.1174	93.8804	94.6120	94.1174	94.6120	(39)
Average = Sum(39)m / 12 =												94.7133	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2029	1.1925	1.1959	1.1891	1.1891	1.1859	1.1828	1.1797	1.1767	1.1859	1.1797	1.1859	(40)
HLP (average)												1.1872	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.6387	206.7456	334.7707	480.9270	553.6537	613.1657	580.1500	514.9947	407.3959	262.1191	156.4787	102.9749	(83)
Total gains	680.6311	756.3355	862.9802	976.0236	1014.8767	1044.0538	993.3226	936.4486	847.9192	735.9668	667.3433	641.8169	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8311	35.1367	35.0367	35.2346	35.2346	35.3306	35.4244	35.5162	35.6059	35.3306	35.5162	35.3306	
alpha	3.3221	3.3424	3.3358	3.3490	3.3490	3.3554	3.3616	3.3677	3.3737	3.3554	3.3677	3.3554	
util living area	0.9622	0.9464	0.9030	0.8109	0.6750	0.4877	0.3621	0.3816	0.6186	0.8439	0.9377	0.9668	(86)
MIT	19.4945	19.6810	20.0572	20.4916	20.7941	20.9489	20.9858	20.9835	20.8861	20.5121	19.9669	19.4826	(87)
Th 2	19.9177	19.9260	19.9233	19.9287	19.9287	19.9313	19.9338	19.9363	19.9387	19.9313	19.9363	19.9313	(88)
util rest of house	0.9546	0.9360	0.8840	0.7753	0.6157	0.4062	0.2668	0.2821	0.5373	0.8046	0.9232	0.9601	(89)
MIT 2	17.9571	18.2283	18.7568	19.3502	19.7302	19.8961	19.9279	19.9293	19.8483	19.3963	18.6486	17.9495	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2747	18.5284	19.0255	19.5860	19.9500	20.1136	20.1464	20.1471	20.0627	19.6268	18.9209	18.2662	(92)

Temperature adjustment -0.1500

adjusted MIT	18.1247	18.3784	18.8755	19.4360	19.8000	19.9636	19.9964	19.9971	19.9127	19.4768	18.7709	18.1162	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9161	0.8613	0.7565	0.6080	0.4087	0.2725	0.2879	0.5351	0.7847	0.9024	0.9440	(94)
Useful gains	637.9109	692.8462	743.2594	738.3389	617.0502	426.7321	270.7128	269.6192	453.7566	577.4850	602.2427	605.8668	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.1530	1244.1987	1132.9829	942.6248	692.5442	441.2317	273.3099	272.6638	489.3675	764.1644	1023.1393	1240.9504	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.6442	370.5089	289.9543	147.0858	56.1676	0.0000	0.0000	0.0000	0.0000	138.8895	303.0455	472.5022	(98)

Space heating 2247.7979 (98)
RHI space heating demand 2248 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8100	
Infiltration rate			0.4345	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5124	0.5023	0.4923	0.4421	0.4320	0.3818	0.3818	0.3717	0.4019	0.4320	0.4521	0.4722	(22b)
Effective ac	0.6313	0.6262	0.6212	0.5977	0.5933	0.5729	0.5729	0.5691	0.5808	0.5933	0.6022	0.6115	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.9620	42.6150	42.2750	40.6778	40.3790	38.9879	38.9879	38.7303	39.5238	40.3790	40.9835	41.6155	(38)
Heat transfer coeff	98.8436	98.4967	98.1566	96.5595	96.2607	94.8696	94.8696	94.6120	95.4054	96.2607	96.8652	97.4972	(39)
Average = Sum(39)m / 12 =												96.5580	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2390	1.2346	1.2303	1.2103	1.2066	1.1891	1.1891	1.1859	1.1959	1.2066	1.2142	1.2221	(40)
HLP (average)												1.2103	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8180	33.9371	34.0547	34.6180	34.7254	35.2346	35.2346	35.3306	35.0367	34.7254	34.5087	34.2850	
alpha	3.2545	3.2625	3.2703	3.3079	3.3150	3.3490	3.3490	3.3554	3.3358	3.3150	3.3006	3.2857	
util living area													
	0.9698	0.9538	0.9195	0.8454	0.7265	0.5678	0.4308	0.4746	0.6927	0.8840	0.9541	0.9739	(86)
MIT	19.2960	19.5243	19.8991	20.3608	20.7077	20.9087	20.9726	20.9619	20.8167	20.3508	19.7497	19.2616	(87)
Th 2	19.8890	19.8924	19.8958	19.9118	19.9147	19.9287	19.9287	19.9313	19.9233	19.9147	19.9087	19.9024	(88)
util rest of house													
	0.9638	0.9447	0.9035	0.8149	0.6740	0.4893	0.3330	0.3744	0.6185	0.8539	0.9435	0.9687	(89)
MIT 2	17.6530	17.9825	18.5170	19.1649	19.6160	19.8575	19.9147	19.9103	19.7636	19.1705	18.3219	17.6119	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9924	18.3010	18.8025	19.4119	19.8415	20.0746	20.1332	20.1275	19.9811	19.4143	18.6168	17.9527	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8424	18.1510	18.6525	19.2619	19.6915	19.9246	19.9832	19.9775	19.8311	19.2643	18.4668	17.8027	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9253	0.8806	0.7935	0.6621	0.4890	0.3382	0.3790	0.6115	0.8315	0.9243	0.9543	(94)
Useful gains	619.3490	684.8922	735.0889	741.2113	658.1346	476.5607	314.9723	329.6186	485.6129	580.2775	586.0610	592.6508	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1338.5819	1305.1756	1192.8439	1000.5433	769.2658	505.1427	320.9654	338.4783	546.7814	834.0321	1101.0504	1326.2211	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	535.1093	416.8305	340.5697	186.7191	82.6816	0.0000	0.0000	0.0000	0.0000	188.7934	370.7923	545.7763	(98)
Space heating												2667.2721	(98)
Space heating per m2											(98) / (4) =	33.4328	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2947.2620	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	535.1093	416.8305	340.5697	186.7191	82.6816	0.0000	0.0000	0.0000	0.0000	188.7934	370.7923	545.7763	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	591.2809	460.5861	376.3201	206.3194	91.3609	0.0000	0.0000	0.0000	0.0000	208.6115	409.7153	603.0678	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7243	89.6526	89.4952	89.1442	88.5283	87.3000	87.3000	87.3000	87.3000	89.1237	89.5620	89.7528	(217)
Fuel for water heating, kWh/month													
	184.0793	161.5584	168.0380	148.5447	144.6223	128.1956	120.4190	135.8687	136.8056	154.2109	165.6208	178.6981	(219)
Water heating fuel used												1826.6612	(219)
Annual totals kWh/year													
Space heating fuel - main system												2947.2620	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4130.9365	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2947.2620	3.4800	102.5647	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.6612	3.4800	63.5678	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			201.3226	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6776	(257)
SAP value		90.5470	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2947.2620	0.2160	636.6086	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.6612	0.2160	394.5588	(264)
Space and water heating			1031.1674	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			697.4573	(272)
CO2 emissions per m2			8.7400	(273)
EI value			92.5101	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8100	
Infiltration rate		0.4345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4220	0.3918	0.4019	0.3818	0.3818	0.3717	0.3617	0.3516	0.3416	0.3717	0.3516	0.3717	(22b)
Effective ac	0.5890	0.5768	0.5808	0.5729	0.5729	0.5691	0.5654	0.5618	0.5583	0.5691	0.5618	0.5691	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0871	39.2524	39.5238	38.9879	38.9879	38.7303	38.4796	38.2357	37.9987	38.7303	38.2357	38.7303	(38)
Heat transfer coeff	95.9687	95.1341	95.4054	94.8696	94.8696	94.6120	94.3612	94.1174	93.8804	94.6120	94.1174	94.6120	(39)
Average = Sum(39)m / 12 =												94.7133	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2029	1.1925	1.1959	1.1891	1.1891	1.1859	1.1828	1.1797	1.1767	1.1859	1.1797	1.1859	(40)
HLP (average)												1.1872	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.6387	206.7456	334.7707	480.9270	553.6537	613.1657	580.1500	514.9947	407.3959	262.1191	156.4787	102.9749	(83)
Total gains	680.6311	756.3355	862.9802	976.0236	1014.8767	1044.0538	993.3226	936.4486	847.9192	735.9668	667.3433	641.8169	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8311	35.1367	35.0367	35.2346	35.2346	35.3306	35.4244	35.5162	35.6059	35.3306	35.5162	35.3306	
alpha	3.3221	3.3424	3.3358	3.3490	3.3490	3.3554	3.3616	3.3677	3.3737	3.3554	3.3677	3.3554	
util living area													
	0.9622	0.9464	0.9030	0.8109	0.6750	0.4877	0.3621	0.3816	0.6186	0.8439	0.9377	0.9668	(86)
MIT	19.4945	19.6810	20.0572	20.4916	20.7941	20.9489	20.9858	20.9835	20.8861	20.5121	19.9669	19.4826	(87)
Th 2	19.9177	19.9260	19.9233	19.9287	19.9287	19.9313	19.9338	19.9363	19.9387	19.9313	19.9363	19.9313	(88)
util rest of house													
	0.9546	0.9360	0.8840	0.7753	0.6157	0.4062	0.2668	0.2821	0.5373	0.8046	0.9232	0.9601	(89)
MIT 2	17.9571	18.2283	18.7568	19.3502	19.7302	19.8961	19.9279	19.9293	19.8483	19.3963	18.6486	17.9495	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2747	18.5284	19.0255	19.5860	19.9500	20.1136	20.1464	20.1471	20.0627	19.6268	18.9209	18.2662	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1247	18.3784	18.8755	19.4360	19.8000	19.9636	19.9964	19.9971	19.9127	19.4768	18.7709	18.1162	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9161	0.8613	0.7565	0.6080	0.4087	0.2725	0.2879	0.5351	0.7847	0.9024	0.9440	(94)
Useful gains	637.9109	692.8462	743.2594	738.3389	617.0502	426.7321	270.7128	269.6192	453.7566	577.4850	602.2427	605.8668	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1269.1530	1244.1987	1132.9829	942.6248	692.5442	441.2317	273.3099	272.6638	489.3675	764.1644	1023.1393	1240.9504	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	469.6442	370.5089	289.9543	147.0858	56.1676	0.0000	0.0000	0.0000	0.0000	138.8895	303.0455	472.5022	(98)
Space heating												2247.7979	(98)
Space heating per m2											(98) / (4) =	28.1750	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2483.7546	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	469.6442	370.5089	289.9543	147.0858	56.1676	0.0000	0.0000	0.0000	0.0000	138.8895	303.0455	472.5022	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	518.9438	409.4021	320.3915	162.5258	62.0637	0.0000	0.0000	0.0000	0.0000	153.4690	334.8569	522.1018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6451	89.5772	89.3811	88.9552	88.2515	87.3000	87.3000	87.3000	87.3000	88.8796	89.4228	89.6671	(217)
Fuel for water heating, kWh/month													
	184.2420	161.6944	168.2524	148.8603	145.0758	128.1956	120.4190	135.8687	136.8056	154.6344	165.8784	178.8689	(219)
Water heating fuel used												1828.7955	(219)
Annual totals kWh/year													
Space heating fuel - main system												2483.7546	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3523.7381	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2483.7546	9.7400	241.9177	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.7955	9.7400	178.1247	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			233.3652	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2483.7546	0.2160	536.4910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.7955	0.2160	395.0198	(264)
Space and water heating			931.5108	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			522.1174	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2483.7546	1.2200	3030.1806	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.7955	1.2200	2231.1305	(264)
Space and water heating			5261.3111	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2839.6583	(272)
Primary energy kWh/m2/year			35.5936	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (35.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.32 kg/m²	A 92	A 94
Total Savings	£77	2.32 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£178	-£18
Mains gas	£524	£429	£95
Space heating	£374	£374	£0
Water heating	£178	£101	£77
Lighting	£132	£132	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£233	£157	£77
Total cost of uses	£234	£157	£77
Delivered energy	44 kWh/m²	33 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	36 kWh/m²	23 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8100	
Infiltration rate			0.4345	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5124	0.5023	0.4923	0.4421	0.4320	0.3818	0.3818	0.3717	0.4019	0.4320	0.4521	0.4722	(22b)
Effective ac	0.6313	0.6262	0.6212	0.5977	0.5933	0.5729	0.5729	0.5691	0.5808	0.5933	0.6022	0.6115	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.9620	42.6150	42.2750	40.6778	40.3790	38.9879	38.9879	38.7303	39.5238	40.3790	40.9835	41.6155	(38)
Heat transfer coeff	98.8436	98.4967	98.1566	96.5595	96.2607	94.8696	94.8696	94.6120	95.4054	96.2607	96.8652	97.4972	(39)
Average = Sum(39)m / 12 =												96.5580	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2390	1.2346	1.2303	1.2103	1.2066	1.1891	1.1891	1.1859	1.1959	1.2066	1.2142	1.2221	(40)
HLP (average)												1.2103	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)

Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)

Solar input (sum of months) = Sum(63)m = -843.3953 (63)

Output from w/h

140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)

Heat gains from water heating, kWh/month

53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)

Water heating gains (Table 5)

72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)

Total internal gains

553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8180	33.9371	34.0547	34.6180	34.7254	35.2346	35.2346	35.3306	35.0367	34.7254	34.5087	34.2850	
alpha	3.2545	3.2625	3.2703	3.3079	3.3150	3.3490	3.3490	3.3554	3.3358	3.3150	3.3006	3.2857	
util living area	0.9698	0.9538	0.9195	0.8454	0.7265	0.5678	0.4308	0.4746	0.6927	0.8840	0.9541	0.9739	(86)
MIT	19.2960	19.5243	19.8991	20.3608	20.7077	20.9087	20.9726	20.9619	20.8167	20.3508	19.7497	19.2616	(87)
Th 2	19.8890	19.8924	19.8958	19.9118	19.9147	19.9287	19.9287	19.9313	19.9233	19.9147	19.9087	19.9024	(88)
util rest of house	0.9638	0.9447	0.9035	0.8149	0.6740	0.4893	0.3330	0.3744	0.6185	0.8539	0.9435	0.9687	(89)
MIT 2	17.6530	17.9825	18.5170	19.1649	19.6160	19.8575	19.9147	19.9103	19.7636	19.1705	18.3219	17.6119	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9924	18.3010	18.8025	19.4119	19.8415	20.0746	20.1332	20.1275	19.9811	19.4143	18.6168	17.9527	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8424	18.1510	18.6525	19.2619	19.6915	19.9246	19.9832	19.9775	19.8311	19.2643	18.4668	17.8027	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9253	0.8806	0.7935	0.6621	0.4890	0.3382	0.3790	0.6115	0.8315	0.9243	0.9543	(94)
Useful gains	619.3490	684.8922	735.0889	741.2113	658.1346	476.5607	314.9723	329.6186	485.6129	580.2775	586.0610	592.6508	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1338.5819	1305.1756	1192.8439	1000.5433	769.2658	505.1427	320.9654	338.4783	546.7814	834.0321	1101.0504	1326.2211	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	535.1093	416.8305	340.5697	186.7191	82.6816	0.0000	0.0000	0.0000	0.0000	188.7934	370.7923	545.7763	(98)

Space heating 2667.2721 (98)
Space heating per m2 (98) / (4) = 33.4328 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2947.2620 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	535.1093	416.8305	340.5697	186.7191	82.6816	0.0000	0.0000	0.0000	0.0000	188.7934	370.7923	545.7763	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	591.2809	460.5861	376.3201	206.3194	91.3609	0.0000	0.0000	0.0000	0.0000	208.6115	409.7153	603.0678	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8146	89.8423	89.8678	89.9272	90.0530	87.3000	87.3000	87.3000	87.3000	89.4795	89.6995	89.8281	(217)
Fuel for water heating, kWh/month	156.6640	115.7917	89.9982	43.6650	14.3803	0.0000	0.0000	24.1300	49.2919	95.2917	133.0263	155.7645	(219)

Water heating fuel used 878.0036 (219)
Annual totals kWh/year
Space heating fuel - main system 2947.2620 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) = -1074.8994 -1074.8994 (233)
Total delivered energy for all uses 3232.2789 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2947.2620	3.4800	102.5647	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.0036	3.4800	30.5545	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			174.9043	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.5887 (257)
SAP value 91.7874
SAP rating (Section 12) 92 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2947.2620	0.2160	636.6086	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.0036	0.2160	189.6488	(264)
Space and water heating			826.2574	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			518.4972	(272)
CO2 emissions per m2			6.5000	(273)
EI value			94.4319	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8100	
Infiltration rate		0.4345	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4019	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4220	0.3918	0.4019	0.3818	0.3818	0.3717	0.3617	0.3516	0.3416	0.3717	0.3516	0.3717	(22b)
Effective ac	0.5890	0.5768	0.5808	0.5729	0.5729	0.5691	0.5654	0.5618	0.5583	0.5691	0.5618	0.5691	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0871	39.2524	39.5238	38.9879	38.9879	38.7303	38.4796	38.2357	37.9987	38.7303	38.2357	38.7303	(38)
Heat transfer coeff	95.9687	95.1341	95.4054	94.8696	94.8696	94.6120	94.3612	94.1174	93.8804	94.6120	94.1174	94.6120	(39)
Average = Sum(39)m / 12 =												94.7133	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2029	1.1925	1.1959	1.1891	1.1891	1.1859	1.1828	1.1797	1.1767	1.1859	1.1797	1.1859	(40)
HLP (average)												1.1872	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                          Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3932 (H8)
Utilisation factor                                                                                                                  0.5122 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -875.5295 (H17)
Solar input    -28.5619   -40.6132   -69.8043   -94.1822  -110.6226  -118.1624  -115.6775  -103.5348   -81.0606   -56.0425   -33.7812   -23.4862 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -875.5295 (63)
Output from w/h
             136.6020   104.2280    80.5815    38.2368    17.4090     0.0000     0.0000    15.0785    38.3707    81.3959   114.5520   136.9003 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    763.3548 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

```
Solar gains    126.6387   206.7456   334.7707   480.9270   553.6537   613.1657   580.1500   514.9947   407.3959   262.1191   156.4787   102.9749 (83)
Total gains    680.6311   756.3355   862.9802   976.0236  1014.8767  1044.0538   993.3226   936.4486   847.9192   735.9668   667.3433   641.8169 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.8311    35.1367    35.0367    35.2346    35.2346    35.3306    35.4244    35.5162    35.6059    35.3306    35.5162    35.3306
alpha         3.3221     3.3424     3.3358     3.3490     3.3490     3.3554     3.3616     3.3677     3.3737     3.3554     3.3677     3.3554
util living area
               0.9622     0.9464     0.9030     0.8109     0.6750     0.4877     0.3621     0.3816     0.6186     0.8439     0.9377     0.9668 (86)

MIT           19.4945    19.6810    20.0572    20.4916    20.7941    20.9489    20.9858    20.9835    20.8861    20.5121    19.9669    19.4826 (87)
Th 2          19.9177    19.9260    19.9233    19.9287    19.9287    19.9313    19.9338    19.9363    19.9387    19.9313    19.9363    19.9313 (88)
util rest of house
               0.9546     0.9360     0.8840     0.7753     0.6157     0.4062     0.2668     0.2821     0.5373     0.8046     0.9232     0.9601 (89)
MIT 2         17.9571    18.2283    18.7568    19.3502    19.7302    19.8961    19.9279    19.9293    19.8483    19.3963    18.6486    17.9495 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.2747    18.5284    19.0255    19.5860    19.9500    20.1136    20.1464    20.1471    20.0627    19.6268    18.9209    18.2662 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1247    18.3784    18.8755    19.4360    19.8000    19.9636    19.9964    19.9971    19.9127    19.4768    18.7709    18.1162 (93)
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9161	0.8613	0.7565	0.6080	0.4087	0.2725	0.2879	0.5351	0.7847	0.9024	0.9440	(94)
Useful gains	637.9109	692.8462	743.2594	738.3389	617.0502	426.7321	270.7128	269.6192	453.7566	577.4850	602.2427	605.8668	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1269.1530	1244.1987	1132.9829	942.6248	692.5442	441.2317	273.3099	272.6638	489.3675	764.1644	1023.1393	1240.9504	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	469.6442	370.5089	289.9543	147.0858	56.1676	0.0000	0.0000	0.0000	0.0000	138.8895	303.0455	472.5022	(98)
Space heating												2247.7979	(98)
Space heating per m2											(98) / (4) =	28.1750	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2483.7546	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	469.6442	370.5089	289.9543	147.0858	56.1676	0.0000	0.0000	0.0000	0.0000	138.8895	303.0455	472.5022	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	518.9438	409.4021	320.3915	162.5258	62.0637	0.0000	0.0000	0.0000	0.0000	153.4690	334.8569	522.1018	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7587	89.7775	89.7843	89.8207	89.7218	87.3000	87.3000	87.3000	87.3000	89.2906	89.5991	89.7609	(217)
Fuel for water heating, kWh/month	152.1881	116.0960	89.7502	42.5701	19.4033	0.0000	0.0000	17.2721	43.9527	91.1584	127.8495	152.5167	(219)
Water heating fuel used												852.7570	(219)

Annual totals kWh/year		
Space heating fuel - main system	2483.7546	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) = -1220.7247	-1220.7247	(233)
Total delivered energy for all uses	2597.6996	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2483.7546	9.7400	241.9177	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.7570	9.7400	83.0585	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			156.7240	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2483.7546	0.2160	536.4910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7570	0.2160	184.1955	(264)
Space and water heating			720.6865	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			337.2431	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2483.7546	1.2200	3030.1806	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7570	1.2200	1040.3635	(264)
Space and water heating			4070.5442	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1802.3913	(272)
Primary energy kWh/m2/year			22.5920	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						644.9508

	Jun	Jul	Aug	
Solar gains	684	645	571	(P4)
Internal gains	428	410	418	
Total summer gains	1112	1055	989	(P5)
Summer gain/loss ratio	3.39	3.22	3.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.33	22.06	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-351	**Issued on Date**	31/05/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	5, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	10.40	**TER**	18.83
Environmental	92 A	**% DER<TER**	44.77		
CO_2 Emissions (t/year)	0.53	**DFEE**	46.82	**TFEE**	54.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.90		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.83 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.40 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.76 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.72 m², No overhang
Windows facing East: 5.06 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.4320	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3996	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5094	0.4995	0.4895	0.4395	0.4295	0.3796	0.3796	0.3696	0.3996	0.4295	0.4495	0.4695	(22b)
Effective ac	0.6298	0.6247	0.6198	0.5966	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6102	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.8594	42.5165	42.1804	40.6015	40.3061	38.9310	38.9310	38.6764	39.4607	40.3061	40.9037	41.5285	(38)
Heat transfer coeff	98.7411	98.3981	98.0620	96.4832	96.1878	94.8127	94.8127	94.5580	95.3423	96.1878	96.7854	97.4101	(39)
Average = Sum(39)m / 12 =												96.4818	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2377	1.2334	1.2292	1.2094	1.2057	1.1884	1.1884	1.1852	1.1951	1.2057	1.2132	1.2210	(40)
HLP (average)												1.2093	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	464.4736	548.4272	649.1701	761.8673	837.3320	829.3170	789.4436	722.3202	635.1359	528.0531	456.5376	437.2541	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8531	33.9711	34.0875	34.6454	34.7517	35.2558	35.2558	35.3507	35.0599	34.7517	34.5372	34.3157	
alpha	3.2569	3.2647	3.2725	3.3097	3.3168	3.3504	3.3504	3.3567	3.3373	3.3168	3.3025	3.2877	
util living area													
	0.9884	0.9793	0.9567	0.8994	0.7931	0.6389	0.4971	0.5531	0.7828	0.9394	0.9812	0.9904	(86)
MIT	19.0058	19.2431	19.6549	20.1859	20.6105	20.8694	20.9580	20.9398	20.7277	20.1478	19.4864	18.9743	(87)
Th 2	19.8900	19.8934	19.8967	19.9125	19.9155	19.9293	19.9293	19.9318	19.9239	19.9155	19.9095	19.9032	(88)
util rest of house													
	0.9858	0.9748	0.9470	0.8764	0.7456	0.5581	0.3885	0.4430	0.7153	0.9208	0.9764	0.9883	(89)
MIT 2	17.2353	17.5816	18.1773	18.9362	19.5049	19.8237	19.9070	19.8971	19.6734	18.9012	17.9479	17.1975	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6010	17.9248	18.4825	19.1944	19.7332	20.0397	20.1241	20.1125	19.8912	19.1587	18.2657	17.5645	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4510	17.7748	18.3325	19.0444	19.5832	19.8897	19.9741	19.9625	19.7412	19.0087	18.1157	17.4145	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9621	0.9281	0.8535	0.7289	0.5548	0.3933	0.4464	0.7019	0.8997	0.9643	0.9808	(94)
Useful gains	453.8562	527.6264	602.5179	650.2749	610.3269	460.1296	310.4970	322.4524	445.7838	475.0793	440.2557	428.8776	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1298.5434	1266.8610	1160.3197	978.7606	758.2713	501.5323	319.9084	336.8613	537.8426	808.8112	1066.1623	1287.2288	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	628.4473	496.7657	415.0046	236.5097	110.0706	0.0000	0.0000	0.0000	0.0000	248.2965	450.6527	638.6133	(98)
Space heating												3224.3605	(98)
Space heating per m2											(98) / (4) =	40.4156	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3562.8292	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	628.4473	496.7657	415.0046	236.5097	110.0706	0.0000	0.0000	0.0000	0.0000	248.2965	450.6527	638.6133	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	694.4169	548.9124	458.5686	261.3367	121.6250	0.0000	0.0000	0.0000	0.0000	274.3608	497.9588	705.6501	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8148	89.7573	89.6262	89.3248	88.7507	87.3000	87.3000	87.3000	87.3000	89.3333	89.6859	89.8390	(217)
Fuel for water heating, kWh/month													
	183.8938	161.3699	167.7923	148.2444	144.2598	128.1956	120.4190	135.8687	136.8056	153.8491	165.3919	178.5266	(219)
Water heating fuel used												1824.6167	(219)
Annual totals kWh/year													
Space heating fuel - main system												3562.8292	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4744.4591	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3562.8292	0.2160	769.5711	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.6167	0.2160	394.1172	(264)
Space and water heating			1163.6883	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			829.9782	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.4000	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		28.8963	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.8963	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	464.4856	536.3195	620.7647	714.3935	775.8493	765.3921	729.1025	672.6332	599.5751	510.8194	453.1960	439.4627	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9983	0.9961	0.9886	0.9590	0.8731	0.7063	0.5388	0.6005	0.8561	0.9797	0.9965	0.9987	(86)
MIT	19.6935	19.8471	20.1210	20.4862	20.7849	20.9479	20.9891	20.9819	20.8584	20.4573	20.0123	19.6720	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9977	0.9948	0.9845	0.9433	0.8264	0.6143	0.4184	0.4769	0.7857	0.9692	0.9950	0.9982	(89)
MIT 2	18.1901	18.4163	18.8162	19.3456	19.7417	19.9295	19.9600	19.9587	19.8442	19.3151	18.6679	18.1665	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9925	0.9798	0.9363	0.8266	0.6310	0.4434	0.5024	0.7932	0.9637	0.9929	0.9973	(94)
Useful gains	462.8205	532.2798	608.2253	668.9029	641.3404	482.9731	323.2806	337.9245	475.5798	492.2513	449.9570	438.2566	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1344.3128	1303.5374	1184.2759	990.9332	763.9970	506.1960	326.4405	343.6765	546.6508	828.1996	1101.9511	1335.6629	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating												3312.8667	(98)
Space heating per m2											(98) / (4) =	41.5250	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3546.9665	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	702.1737	554.9091	458.8669	248.2460	97.7050	0.0000	0.0000	0.0000	0.0000	267.6077	502.6078	714.8504	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7995	87.5920	87.1036	85.9289	83.7191	80.3000	80.3000	80.3000	80.3000	85.9979	87.3182	87.8793	(217)
Fuel for water heating, kWh/month	230.0739	202.3931	211.7577	190.3861	189.1926	173.7253	166.4421	185.5439	187.5930	199.4590	209.6990	224.4415	(219)
Water heating fuel used												2370.7072	(219)
Annual totals kWh/year													
Space heating fuel - main system												3546.9665	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6349.5864	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3546.9665	0.2160	766.1448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.7072	0.2160	512.0728	(264)
Space and water heating			1278.2175	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1502.3802	(272)
Emissions per m2 for space and water heating			16.0218	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0218 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.3835	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4523	0.4434	0.4345	0.3902	0.3813	0.3370	0.3370	0.3281	0.3547	0.3813	0.3990	0.4168	(22b)
Effective ac	0.6023	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5869	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9880	40.7178	40.4528	39.2086	38.9758	37.8921	37.8921	37.6914	38.3095	38.9758	39.4467	39.9391	(38)
Heat transfer coeff	96.8697	96.5994	96.3345	95.0902	94.8574	93.7737	93.7737	93.5730	94.1911	94.8574	95.3284	95.8207	(39)
Average = Sum(39)m / 12 =												95.0891	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2142	1.2108	1.2075	1.1919	1.1890	1.1754	1.1754	1.1729	1.1806	1.1890	1.1949	1.2011	(40)
HLP (average)												1.1919	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	432.3673	517.0988	619.4567	734.3470	811.2364	805.2253	767.0523	697.7471	609.7854	500.4330	426.3545	405.9203	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5071	34.6037	34.6988	35.1529	35.2391	35.6464	35.6464	35.7228	35.4884	35.2391	35.0650	34.8849	
alpha	3.3005	3.3069	3.3133	3.3435	3.3493	3.3764	3.3764	3.3815	3.3659	3.3493	3.3377	3.3257	
util living area													
	0.9906	0.9823	0.9612	0.9060	0.8012	0.6481	0.5051	0.5644	0.7949	0.9465	0.9845	0.9923	(86)
MIT	18.9943	19.2325	19.6463	20.1770	20.6059	20.8667	20.9571	20.9376	20.7190	20.1294	19.4657	18.9578	(87)
Th 2	19.9086	19.9114	19.9140	19.9265	19.9288	19.9397	19.9397	19.9418	19.9355	19.9288	19.9241	19.9192	(88)
util rest of house													
	0.9885	0.9785	0.9525	0.8843	0.7550	0.5678	0.3963	0.4541	0.7294	0.9297	0.9804	0.9906	(89)
MIT 2	18.0798	18.3180	18.7278	19.2495	19.6435	19.8656	19.9241	19.9169	19.7571	19.2165	18.5607	18.0510	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2687	18.5069	18.9175	19.4411	19.8423	20.0724	20.1375	20.1277	19.9558	19.4051	18.7476	18.2383	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2687	18.5069	18.9175	19.4411	19.8423	20.0724	20.1375	20.1277	19.9558	19.4051	18.7476	18.2383	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9718	0.9421	0.8725	0.7508	0.5786	0.4176	0.4747	0.7309	0.9192	0.9744	0.9869	(94)
Useful gains	425.5039	502.4928	583.6107	640.7282	609.0909	465.9278	320.3250	331.2438	445.6658	459.9977	415.4194	400.6183	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.1409	1314.4160	1196.2374	1002.3543	772.3612	513.1656	331.7223	348.8144	551.5662	835.2289	1110.3493	1345.1600	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	690.1619	545.6123	455.7942	260.3708	121.4731	0.0000	0.0000	0.0000	0.0000	279.1720	500.3495	702.7390	(98)
Space heating												3555.6729	(98)
Space heating per m2											(98) / (4) =	44.5685	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													

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	0.0000	0.0000	0.0000	0.0000	0.0000	881.4728	693.9254	711.1549	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8285	0.8849	0.8554	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	730.3016	614.0690	608.3061	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1033.1059	986.6144	907.2322	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	218.0191	277.1738	222.4010	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												717.5939	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.5048	69.2934	55.6002	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												179.3985	(107)
Space cooling per m2												2.2487	(108)
Energy for space heating												44.5685	(99)
Energy for space cooling												2.2487	(108)
Total												46.8171	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	420.0002	492.9230	579.6054	676.0477	739.5525	731.7217	697.1254	637.8524	563.3892	471.7437	410.9391	395.7460	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9989	0.9973	0.9915	0.9666	0.8894	0.7293	0.5609	0.6280	0.8788	0.9853	0.9977	0.9992	(86)
MIT	19.6419	19.7972	20.0753	20.4491	20.7617	20.9398	20.9870	20.9779	20.8371	20.4154	19.9635	19.6210	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9985	0.9964	0.9883	0.9533	0.8461	0.6376	0.4369	0.5012	0.8142	0.9774	0.9967	0.9989	(89)
MIT 2	18.6908	18.8481	19.1268	19.5028	19.7904	19.9363	19.9607	19.9598	19.8661	19.4773	19.0252	18.6789	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9858	0.9493	0.8480	0.6548	0.4628	0.5276	0.8221	0.9745	0.9958	0.9985	(94)
Useful gains	419.1443	490.5901	571.3602	641.7939	627.1262	479.1676	322.6256	336.5415	463.1510	459.7196	409.2036	395.1474	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1380.9137	1334.8978	1206.5707	1001.7884	767.1336	506.5306	326.4500	343.6823	547.8447	839.3066	1127.3915	1372.7109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	715.5564	567.3748	472.5966	259.1960	104.1655	0.0000	0.0000	0.0000	0.0000	282.4127	517.0953	727.3073	(98)
Space heating												3645.7045	(98)
Space heating per m2											(98) / (4) =	45.6970	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8725	0.9298	0.9028	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	749.3878	628.6644	625.4848	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	947.1926	904.8817	837.2253	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	142.4195	205.5057	157.5349	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												505.4600	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	35.6049	51.3764	39.3837	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.3650 (107)
Space cooling per m2												1.5839 (108)
Energy for space heating												45.6970 (99)
Energy for space cooling												1.5839 (108)
Total												47.2809 (109)
Target Fabric Energy Efficiency (TFEE)												54.4 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.4320	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3996	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4195	0.3896	0.3996	0.3796	0.3796	0.3696	0.3596	0.3496	0.3396	0.3696	0.3496	0.3696	(22b)
Effective ac	0.5880	0.5759	0.5798	0.5720	0.5720	0.5683	0.5647	0.5611	0.5577	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0175	39.1925	39.4607	38.9310	38.9310	38.6764	38.4285	38.1875	37.9532	38.6764	38.1875	38.6764	(38)
Heat transfer coeff	95.8992	95.0741	95.3423	94.8127	94.8127	94.5580	94.3102	94.0691	93.8348	94.5580	94.0691	94.5580	(39)
Average = Sum(39)m / 12 =												94.6582	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1917	1.1951	1.1884	1.1884	1.1852	1.1821	1.1791	1.1762	1.1852	1.1791	1.1852	(40)
HLP (average)												1.1865	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	13.4839	0.4600	0.0000	0.7700	3.4387	(74)
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	115.6033	192.2997	318.8331	467.4602	544.6342	605.9078	572.1935	503.3912	391.4669	246.0631	143.6392	93.4752	(83)
Total gains	669.5957	741.8896	847.0426	962.5568	1005.8571	1036.7959	985.3662	924.8451	831.9902	719.9108	654.5037	632.3172	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8563	35.1588	35.0599	35.2558	35.2558	35.3507	35.4436	35.5345	35.6232	35.3507	35.5345	35.3507	
alpha	3.3238	3.3439	3.3373	3.3504	3.3504	3.3567	3.3629	3.3690	3.3749	3.3567	3.3690	3.3567	
util living area	0.9638	0.9490	0.9070	0.8156	0.6787	0.4904	0.3646	0.3859	0.6269	0.8505	0.9406	0.9682	(86)
MIT	19.4799	19.6624	20.0399	20.4817	20.7908	20.9481	20.9855	20.9830	20.8814	20.4980	19.9506	19.4696	(87)
Th 2	19.9184	19.9266	19.9239	19.9293	19.9293	19.9318	19.9343	19.9368	19.9391	19.9318	19.9368	19.9318	(88)
util rest of house	0.9565	0.9389	0.8886	0.7804	0.6195	0.4086	0.2688	0.2854	0.5454	0.8122	0.9267	0.9616	(89)
MIT 2	17.9368	18.2025	18.7337	19.3384	19.7273	19.8961	19.9283	19.9295	19.8447	19.3793	18.6264	17.9313	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2555	18.5041	19.0035	19.5745	19.9470	20.1134	20.1467	20.1471	20.0588	19.6104	18.8999	18.2491	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1055	18.3541	18.8535	19.4245	19.7970	19.9634	19.9967	19.9971	19.9088	19.4604	18.7499	18.0991	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9194	0.8659	0.7613	0.6116	0.4111	0.2746	0.2913	0.5429	0.7919	0.9062	0.9459	(94)
Useful gains	629.0700	682.0908	733.4689	732.8194	615.1440	426.2352	270.5342	269.3828	451.6595	570.1233	593.1420	598.0908	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1266.3988	1241.1023	1130.1439	940.9724	691.8450	440.9623	273.1855	272.5316	488.7710	762.1776	1020.6396	1238.6240	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	474.1726	375.6557	295.1262	149.8701	57.0655	0.0000	0.0000	0.0000	0.0000	142.8884	307.7982	476.5567	(98)

Space heating 2279.1336 (98)
RHI space heating demand 2279 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.7600	
Infiltration rate		0.4320	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3996	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5094	0.4995	0.4895	0.4395	0.4295	0.3796	0.3796	0.3696	0.3996	0.4295	0.4495	0.4695	(22b)
Effective ac	0.6298	0.6247	0.6198	0.5966	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6102	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.8594	42.5165	42.1804	40.6015	40.3061	38.9310	38.9310	38.6764	39.4607	40.3061	40.9037	41.5285	(38)
Heat transfer coeff	98.7411	98.3981	98.0620	96.4832	96.1878	94.8127	94.8127	94.5580	95.3423	96.1878	96.7854	97.4101	(39)
Average = Sum(39)m / 12 =												96.4818	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2377	1.2334	1.2292	1.2094	1.2057	1.1884	1.1884	1.1852	1.1951	1.2057	1.2132	1.2210	(40)
HLP (average)												1.2093	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8531	33.9711	34.0875	34.6454	34.7517	35.2558	35.2558	35.3507	35.0599	34.7517	34.5372	34.3157	
alpha	3.2569	3.2647	3.2725	3.3097	3.3168	3.3504	3.3504	3.3567	3.3373	3.3168	3.3025	3.2877	
util living area													
	0.9709	0.9560	0.9231	0.8498	0.7306	0.5711	0.4341	0.4800	0.7008	0.8892	0.9561	0.9748	(86)
MIT	19.2846	19.5063	19.8811	20.3491	20.7029	20.9072	20.9720	20.9607	20.8101	20.3358	19.7360	19.2513	(87)
Th 2	19.8900	19.8934	19.8967	19.9125	19.9155	19.9293	19.9293	19.9318	19.9239	19.9155	19.9095	19.9032	(88)
util rest of house													
	0.9651	0.9473	0.9076	0.8199	0.6783	0.4925	0.3358	0.3790	0.6270	0.8600	0.9459	0.9698	(89)
MIT 2	17.6373	17.9576	18.4928	19.1505	19.6112	19.8567	19.9149	19.9101	19.7577	19.1515	18.3031	17.5977	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9776	18.2775	18.7796	19.3981	19.8367	20.0737	20.1333	20.1271	19.9751	19.3961	18.5991	17.9393	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8276	18.1275	18.6296	19.2481	19.6867	19.9237	19.9833	19.9771	19.8251	19.2461	18.4491	17.7893	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9283	0.8848	0.7983	0.6661	0.4921	0.3409	0.3835	0.6194	0.8376	0.9271	0.9556	(94)
Useful gains	611.6784	673.8174	724.4454	734.5076	655.2834	475.6946	314.6499	329.0828	482.3925	572.0441	577.7810	585.8173	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1335.7249	1301.5603	1189.4532	998.4180	768.2264	504.7572	320.7795	338.2459	545.8423	831.6525	1098.4250	1323.7320	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	538.6905	421.8432	345.9658	190.0155	84.0296	0.0000	0.0000	0.0000	0.0000	193.1487	374.8637	549.0085	(98)
Space heating												2697.5655	(98)
Space heating per m2											(98) / (4) =	33.8126	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2980.7354	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	538.6905	421.8432	345.9658	190.0155	84.0296	0.0000	0.0000	0.0000	0.0000	193.1487	374.8637	549.0085	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	595.2382	466.1251	382.2827	209.9619	92.8504	0.0000	0.0000	0.0000	0.0000	213.4239	414.2140	606.6393	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7282	89.6600	89.5060	89.1578	88.5406	87.3000	87.3000	87.3000	87.3000	89.1416	89.5692	89.7562	(217)
Fuel for water heating, kWh/month													
	184.0713	161.5450	168.0177	148.5219	144.6022	128.1956	120.4190	135.8687	136.8056	154.1800	165.6074	178.6913	(219)
Water heating fuel used												1826.5258	(219)
Annual totals kWh/year													
Space heating fuel - main system												2980.7354	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4164.2744	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2980.7354	3.4800	103.7296	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.5258	3.4800	63.5631	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			202.4827	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6815	(257)
SAP value		90.4925	
SAP rating (Section 12)		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2980.7354	0.2160	643.8388	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.5258	0.2160	394.5296	(264)
Space and water heating			1038.3684	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			704.6583	(272)
CO2 emissions per m2			8.8300	(273)
EI value			92.4327	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.7600	
Infiltration rate		0.4320	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3996	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4195	0.3896	0.3996	0.3796	0.3796	0.3696	0.3596	0.3496	0.3396	0.3696	0.3496	0.3696	(22b)
Effective ac	0.5880	0.5759	0.5798	0.5720	0.5720	0.5683	0.5647	0.5611	0.5577	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0175	39.1925	39.4607	38.9310	38.9310	38.6764	38.4285	38.1875	37.9532	38.6764	38.1875	38.6764	(38)
Heat transfer coeff	95.8992	95.0741	95.3423	94.8127	94.8127	94.5580	94.3102	94.0691	93.8348	94.5580	94.0691	94.5580	(39)
Average = Sum(39)m / 12 =												94.6582	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1917	1.1951	1.1884	1.1884	1.1852	1.1821	1.1791	1.1762	1.1852	1.1791	1.1852	(40)
HLP (average)												1.1865	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	13.4839	0.4600	0.0000	0.7700	3.4387	(74)
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	115.6033	192.2997	318.8331	467.4602	544.6342	605.9078	572.1935	503.3912	391.4669	246.0631	143.6392	93.4752	(83)
Total gains	669.5957	741.8896	847.0426	962.5568	1005.8571	1036.7959	985.3662	924.8451	831.9902	719.9108	654.5037	632.3172	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8563	35.1588	35.0599	35.2558	35.2558	35.3507	35.4436	35.5345	35.6232	35.3507	35.5345	35.3507	
alpha	3.3238	3.3439	3.3373	3.3504	3.3504	3.3567	3.3629	3.3690	3.3749	3.3567	3.3690	3.3567	
util living area													
	0.9638	0.9490	0.9070	0.8156	0.6787	0.4904	0.3646	0.3859	0.6269	0.8505	0.9406	0.9682	(86)
MIT	19.4799	19.6624	20.0399	20.4817	20.7908	20.9481	20.9855	20.9830	20.8814	20.4980	19.9506	19.4696	(87)
Th 2	19.9184	19.9266	19.9239	19.9293	19.9293	19.9318	19.9343	19.9368	19.9391	19.9318	19.9368	19.9318	(88)
util rest of house													
	0.9565	0.9389	0.8886	0.7804	0.6195	0.4086	0.2688	0.2854	0.5454	0.8122	0.9267	0.9616	(89)
MIT 2	17.9368	18.2025	18.7337	19.3384	19.7273	19.8961	19.9283	19.9295	19.8447	19.3793	18.6264	17.9313	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2555	18.5041	19.0035	19.5745	19.9470	20.1134	20.1467	20.1471	20.0588	19.6104	18.8999	18.2491	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1055	18.3541	18.8535	19.4245	19.7970	19.9634	19.9967	19.9971	19.9088	19.4604	18.7499	18.0991	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9194	0.8659	0.7613	0.6116	0.4111	0.2746	0.2913	0.5429	0.7919	0.9062	0.9459	(94)
Useful gains	629.0700	682.0908	733.4689	732.8194	615.1440	426.2352	270.5342	269.3828	451.6595	570.1233	593.1420	598.0908	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1266.3988	1241.1023	1130.1439	940.9724	691.8450	440.9623	273.1855	272.5316	488.7710	762.1776	1020.6396	1238.6240	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	474.1726	375.6557	295.1262	149.8701	57.0655	0.0000	0.0000	0.0000	0.0000	142.8884	307.7982	476.5567	(98)
Space heating												2279.1336	(98)
Space heating per m2											(98) / (4) =	28.5677	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2518.3797	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	474.1726	375.6557	295.1262	149.8701	57.0655	0.0000	0.0000	0.0000	0.0000	142.8884	307.7982	476.5567	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	523.9476	415.0892	326.1063	165.6024	63.0558	0.0000	0.0000	0.0000	0.0000	157.8878	340.1085	526.5820	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6511	89.5862	89.3939	88.9702	88.2622	87.3000	87.3000	87.3000	87.3000	88.9023	89.4339	89.6723	(217)
Fuel for water heating, kWh/month													
	184.2297	161.6781	168.2283	148.8352	145.0583	128.1956	120.4190	135.8687	136.8056	154.5949	165.8579	178.8584	(219)
Water heating fuel used												1828.6296	(219)
Annual totals kWh/year													
Space heating fuel - main system												2518.3797	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3558.1973	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2518.3797	9.7400	245.2902	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.6296	9.7400	178.1085	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			236.7215	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2518.3797	0.2160	543.9700	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.6296	0.2160	394.9840	(264)
Space and water heating			938.9540	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			529.5606	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2518.3797	1.2200	3072.4232	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.6296	1.2200	2230.9281	(264)
Space and water heating			5303.3513	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2881.6984	(272)
Primary energy kWh/m2/year			36.1206	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: A 92

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (34.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.32 kg/m²	A 92	A 94
Total Savings	£77	2.32 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£178	-£18
Mains gas	£527	£432	£95
Space heating	£377	£377	£0
Water heating	£178	£101	£77
Lighting	£132	£132	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£236	£160	£77
Total cost of uses	£237	£160	£77
Delivered energy	45 kWh/m²	33 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	36 kWh/m²	23 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1940 (8)
Pressure test				Yes
Measured/design AP50				4.7600
Infiltration rate				0.4320 (18)
Number of sides sheltered				1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3996 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5094	0.4995	0.4895	0.4395	0.4295	0.3796	0.3796	0.3696	0.3996	0.4295	0.4495	0.4695	(22b)
Effective ac	0.6298	0.6247	0.6198	0.5966	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6102	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.8594	42.5165	42.1804	40.6015	40.3061	38.9310	38.9310	38.6764	39.4607	40.3061	40.9037	41.5285	(38)
Heat transfer coeff	98.7411	98.3981	98.0620	96.4832	96.1878	94.8127	94.8127	94.5580	95.3423	96.1878	96.7854	97.4101	(39)
Average = Sum(39)m / 12 =												96.4818	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2377	1.2334	1.2292	1.2094	1.2057	1.1884	1.1884	1.1852	1.1951	1.2057	1.2132	1.2210	(40)
HLP (average)												1.2093	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                                  Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                     3.0000 (H1)
Zero-loss collector efficiency                                                                                                       0.7000 (H2)
Collector heat loss coefficient                                                                                                      1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                            0.0050 (H3a)
Collector effective heat loss coefficient                                                                                            1.8063 (H3b)
Collector performance ratio                                                                                                          2.5804 (H4)
Annual solar radiation per m2                                                                                                     1079.5246 (H5)
Overshading factor                                                                                                                   0.8000 (H6)
Solar energy available                                                                                                            1813.6014 (H7)
Adjustment factor for showers                                                                                                        1.0000 (H7a)
Solar-to-load ratio                                                                                                                  1.2449 (H8)
Utilisation factor                                                                                                                   0.5521 (H9)
Collector performance factor                                                                                                         0.8793 (H10)
Dedicated solar storage volume                                                                                                      75.0000 (H11)
Effective solar volume                                                                                                              75.0000 (H13)
Daily hot water demand                                                                                                              92.5935 (H14)
Volume ratio Veff/V                                                                                                                  0.8100 (H15)
Solar storage volume factor                                                                                                          0.9579 (H16)
Solar input                                                                                                                       -843.3953 (H17)
Solar input    -24.4568   -40.8113   -69.5064   -93.1523  -115.0818  -113.1437  -111.6485   -97.5478   -76.3995   -52.1719   -29.0093   -20.4662 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -843.3953 (63)
Output from w/h
              140.7071   104.0299    80.8795    39.2667    12.9499     0.0000     0.0000    21.0655    43.0318    85.2666   119.3239   139.9203 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    786.4412 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
North                                  0.7200            10.6334            0.4600           0.0000           0.7700            2.7118 (74)
East                                   5.0600            19.6403            0.4600           0.0000           0.7700           35.2003 (76)
West                                   3.0000            19.6403            0.4600           0.0000           0.7700           20.8697 (80)
West                                   4.5100            19.6403            0.4600           0.0000           0.7700           31.3742 (80)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains     90.1560   176.2418   290.5166   425.0028   522.5763   535.8425   509.7684   436.6339   338.2288   209.1454   112.3780    74.1705 (83)
Total gains    644.1484   725.8317   818.7261   920.0994   983.7992   966.7307   922.9410   858.0878   778.7521   682.9930   623.2425   613.0125 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                         21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            33.8531    33.9711    34.0875    34.6454    34.7517    35.2558    35.2558    35.3507    35.0599    34.7517    34.5372    34.3157
alpha           3.2569     3.2647     3.2725     3.3097     3.3168     3.3504     3.3504     3.3567     3.3373     3.3168     3.3025     3.2877
util living area
                0.9709     0.9560     0.9231     0.8498     0.7306     0.5711     0.4341     0.4800     0.7008     0.8892     0.9561     0.9748 (86)

MIT            19.2846    19.5063    19.8811    20.3491    20.7029    20.9072    20.9720    20.9607    20.8101    20.3358    19.7360    19.2513 (87)
Th 2           19.8900    19.8934    19.8967    19.9125    19.9155    19.9293    19.9293    19.9318    19.9239    19.9155    19.9095    19.9032 (88)
util rest of house
                0.9651     0.9473     0.9076     0.8199     0.6783     0.4925     0.3358     0.3790     0.6270     0.8600     0.9459     0.9698 (89)
MIT 2          17.6373    17.9576    18.4928    19.1505    19.6112    19.8567    19.9149    19.9101    19.7577    19.1515    18.3031    17.5977 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2066 (91)
MIT            17.9776    18.2775    18.7796    19.3981    19.8367    20.0737    20.1333    20.1271    19.9751    19.3961    18.5991    17.9393 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   17.8276    18.1275    18.6296    19.2481    19.6867    19.9237    19.9833    19.9771    19.8251    19.2461    18.4491    17.7893 (93)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9283	0.8848	0.7983	0.6661	0.4921	0.3409	0.3835	0.6194	0.8376	0.9271	0.9556	(94)
Useful gains	611.6784	673.8174	724.4454	734.5076	655.2834	475.6946	314.6499	329.0828	482.3925	572.0441	577.7810	585.8173	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1335.7249	1301.5603	1189.4532	998.4180	768.2264	504.7572	320.7795	338.2459	545.8423	831.6525	1098.4250	1323.7320	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	538.6905	421.8432	345.9658	190.0155	84.0296	0.0000	0.0000	0.0000	0.0000	193.1487	374.8637	549.0085	(98)
Space heating												2697.5655	(98)
Space heating per m2											(98) / (4) =	33.8126	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2980.7354	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	538.6905	421.8432	345.9658	190.0155	84.0296	0.0000	0.0000	0.0000	0.0000	193.1487	374.8637	549.0085	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	595.2382	466.1251	382.2827	209.9619	92.8504	0.0000	0.0000	0.0000	0.0000	213.4239	414.2140	606.6393	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8181	89.8485	89.8758	89.9354	90.0592	87.3000	87.3000	87.3000	87.3000	89.4953	89.7060	89.8312	(217)
Fuel for water heating, kWh/month													
	156.6578	115.7837	89.9903	43.6610	14.3793	0.0000	0.0000	24.1300	49.2919	95.2749	133.0166	155.7591	(219)
Water heating fuel used												877.9445	(219)
Annual totals kWh/year													
Space heating fuel - main system												2980.7354	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												3265.6932	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2980.7354	3.4800	103.7296	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9445	3.4800	30.5525	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			176.0671	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5926	(257)
SAP value	91.7328	
SAP rating (Section 12)	92	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2980.7354	0.2160	643.8388	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9445	0.2160	189.6360	(264)
Space and water heating			833.4749	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			525.7147	(272)
CO2 emissions per m2			6.5900	(273)
EI value			94.3544	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.7600	
Infiltration rate			0.4320	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3996	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4195	0.3896	0.3996	0.3796	0.3796	0.3696	0.3596	0.3496	0.3396	0.3696	0.3496	0.3696	(22b)
Effective ac	0.5880	0.5759	0.5798	0.5720	0.5720	0.5683	0.5647	0.5611	0.5577	0.5683	0.5611	0.5683	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0175	39.1925	39.4607	38.9310	38.9310	38.6764	38.4285	38.1875	37.9532	38.6764	38.1875	38.6764	(38)
Heat transfer coeff	95.8992	95.0741	95.3423	94.8127	94.8127	94.5580	94.3102	94.0691	93.8348	94.5580	94.0691	94.5580	(39)
Average = Sum(39)m / 12 =												94.6582	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1917	1.1951	1.1884	1.1884	1.1852	1.1821	1.1791	1.1762	1.1852	1.1791	1.1852	(40)
HLP (average)												1.1865	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3932 (H8)
Utilisation factor                                                                                                                  0.5122 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -875.5295 (H17)
Solar input    -28.5619   -40.6132   -69.8043   -94.1822  -110.6226  -118.1624  -115.6775  -103.5348   -81.0606   -56.0425   -33.7812   -23.4862 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -875.5295 (63)
Output from w/h
             136.6020   104.2280    80.5815    38.2368    17.4090     0.0000     0.0000    15.0785    38.3707    81.3959   114.5520   136.9003 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    763.3548 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF           Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
North                                  0.7200           13.4839           0.4600           0.0000           0.7700           3.4387 (74)
East                                   5.0600           25.1925           0.4600           0.0000           0.7700          45.1514 (76)
West                                   3.0000           25.1925           0.4600           0.0000           0.7700          26.7696 (80)
West                                   4.5100           25.1925           0.4600           0.0000           0.7700          40.2436 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains    115.6033   192.2997   318.8331   467.4602   544.6342   605.9078   572.1935   503.3912   391.4669   246.0631   143.6392    93.4752 (83)
Total gains    669.5957   741.8896   847.0426   962.5568  1005.8571  1036.7959   985.3662   924.8451   831.9902   719.9108   654.5037   632.3172 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.8563    35.1588    35.0599    35.2558    35.2558    35.3507    35.4436    35.5345    35.6232    35.3507    35.5345    35.3507
alpha         3.3238     3.3439     3.3373     3.3504     3.3504     3.3567     3.3629     3.3690     3.3749     3.3567     3.3690     3.3567
util living area
              0.9638     0.9490     0.9070     0.8156     0.6787     0.4904     0.3646     0.3859     0.6269     0.8505     0.9406     0.9682 (86)

MIT          19.4799    19.6624    20.0399    20.4817    20.7908    20.9481    20.9855    20.9830    20.8814    20.4980    19.9506    19.4696 (87)
Th 2          19.9184    19.9266    19.9239    19.9293    19.9293    19.9318    19.9343    19.9368    19.9391    19.9318    19.9368    19.9318 (88)
util rest of house
              0.9565     0.9389     0.8886     0.7804     0.6195     0.4086     0.2688     0.2854     0.5454     0.8122     0.9267     0.9616 (89)
MIT 2        17.9368    18.2025    18.7337    19.3384    19.7273    19.8961    19.9283    19.9295    19.8447    19.3793    18.6264    17.9313 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT          18.2555    18.5041    19.0035    19.5745    19.9470    20.1134    20.1467    20.1471    20.0588    19.6104    18.8999    18.2491 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT 18.1055    18.3541    18.8535    19.4245    19.7970    19.9634    19.9967    19.9971    19.9088    19.4604    18.7499    18.0991 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9395	0.9194	0.8659	0.7613	0.6116	0.4111	0.2746	0.2913	0.5429	0.7919	0.9062	0.9459	(94)
Useful gains	629.0700	682.0908	733.4689	732.8194	615.1440	426.2352	270.5342	269.3828	451.6595	570.1233	593.1420	598.0908	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1266.3988	1241.1023	1130.1439	940.9724	691.8450	440.9623	273.1855	272.5316	488.7710	762.1776	1020.6396	1238.6240	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	474.1726	375.6557	295.1262	149.8701	57.0655	0.0000	0.0000	0.0000	0.0000	142.8884	307.7982	476.5567	(98)
Space heating												2279.1336	(98)
Space heating per m2											(98) / (4) =	28.5677	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2518.3797	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	474.1726	375.6557	295.1262	149.8701	57.0655	0.0000	0.0000	0.0000	0.0000	142.8884	307.7982	476.5567	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	523.9476	415.0892	326.1063	165.6024	63.0558	0.0000	0.0000	0.0000	0.0000	157.8878	340.1085	526.5820	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7641	89.7852	89.7941	89.8307	89.7311	87.3000	87.3000	87.3000	87.3000	89.3119	89.6091	89.7657	(217)
Fuel for water heating, kWh/month	152.1789	116.0860	89.7404	42.5654	19.4013	0.0000	0.0000	17.2721	43.9527	91.1367	127.8352	152.5085	(219)
Water heating fuel used												852.6770	(219)
Annual totals kWh/year													
Space heating fuel - main system												2518.3797	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												2632.2447	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2518.3797	9.7400	245.2902	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.6770	9.7400	83.0507	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			160.0887	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2518.3797	0.2160	543.9700	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6770	0.2160	184.1782	(264)
Space and water heating			728.1482	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			344.7048	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2518.3797	1.2200	3072.4232	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6770	1.2200	1040.2660	(264)
Space and water heating			4112.6892	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1844.5363	(272)
Primary energy kWh/m2/year			23.1203	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.7200	81.1852	0.4600	0.0000	0.9000	24.1997
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						635.7041

	Jun	Jul	Aug	
Solar gains	675	636	558	(P4)
Internal gains	428	410	418	
Total summer gains	1103	1046	976	(P5)
Summer gain/loss ratio	3.36	3.19	2.97	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.31	22.03	21.72	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-352.R	**Issued on Date**	31/05/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	4, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.26	**TER**	18.71
Environmental	93 A	**% DER<TER**	45.15		
CO_2 Emissions (t/year)	0.52	**DFEE**	46.21	**TFEE**	53.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.03		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.71 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.26 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.66 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 5.06 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	473.6848	562.7715	665.2376	775.8349	847.5725	837.1112	797.9449	733.9616	650.5315	542.9455	467.3250	445.2959	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9877	0.9777	0.9538	0.8951	0.7883	0.6344	0.4922	0.5458	0.7734	0.9350	0.9799	0.9899	(86)
MIT	19.0249	19.2694	19.6812	20.2041	20.6194	20.8726	20.9593	20.9424	20.7391	20.1695	19.5062	18.9911	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9850	0.9729	0.9436	0.8714	0.7404	0.5537	0.3844	0.4365	0.7049	0.9154	0.9748	0.9877	(89)
MIT 2	17.2642	17.6207	18.2157	18.9617	19.5166	19.8276	19.9089	19.8998	19.6866	18.9317	17.9773	17.2229	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6279	17.9612	18.5184	19.2183	19.7444	20.0435	20.1259	20.1151	19.9040	19.1874	18.2931	17.5881	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4779	17.8112	18.3684	19.0683	19.5944	19.8935	19.9759	19.9651	19.7540	19.0374	18.1431	17.4381	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9597	0.9242	0.8485	0.7240	0.5506	0.3893	0.4400	0.6922	0.8939	0.9623	0.9799	(94)
Useful gains	462.3101	540.0716	614.8358	658.3293	613.6676	460.9290	310.6065	322.9697	450.3028	485.3303	449.6870	436.3564	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1298.5200	1267.9192	1161.6155	979.5321	758.2056	501.2912	319.6972	336.7310	538.3602	810.3573	1067.0671	1287.2426	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	622.1402	489.1136	406.8041	231.2661	107.5363	0.0000	0.0000	0.0000	0.0000	241.8201	444.5137	633.0593	(98)
Space heating												3176.2533	(98)
Space heating per m2											(98) / (4) =	39.8127	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3509.6721	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	622.1402	489.1136	406.8041	231.2661	107.5363	0.0000	0.0000	0.0000	0.0000	241.8201	444.5137	633.0593	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	687.4477	540.4570	449.5073	255.5426	118.8246	0.0000	0.0000	0.0000	0.0000	267.2045	491.1753	699.5130	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8094	89.7484	89.6134	89.3081	88.7323	87.3000	87.3000	87.3000	87.3000	89.3136	89.6775	89.8344	(217)
Fuel for water heating, kWh/month													
	183.9049	161.3859	167.8162	148.2721	144.2898	128.1956	120.4190	135.8687	136.8056	153.8830	165.4073	178.5358	(219)
Water heating fuel used												1824.7838	(219)
Annual totals kWh/year													
Space heating fuel - main system												3509.6721	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4691.4692	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3509.6721	0.2160	758.0892	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.7838	0.2160	394.1533	(264)
Space and water heating			1152.2425	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total CO2, kg/year			818.5323	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.2600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.2600	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		28.7563	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7563	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	472.4332	548.6961	634.6280	726.4452	784.6852	772.1171	736.4376	682.6777	612.8588	523.6690	462.5036	446.4014	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9957	0.9875	0.9564	0.8690	0.7017	0.5339	0.5929	0.8475	0.9776	0.9961	0.9986	(86)
MIT	19.7027	19.8613	20.1362	20.4976	20.7902	20.9494	20.9896	20.9828	20.8656	20.4708	20.0230	19.6801	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9942	0.9830	0.9399	0.8215	0.6097	0.4144	0.4703	0.7753	0.9662	0.9945	0.9981	(89)
MIT 2	18.2035	18.4369	18.8381	19.3610	19.7477	19.9306	19.9602	19.9592	19.8512	19.3338	18.6834	18.1783	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9918	0.9781	0.9329	0.8221	0.6266	0.4392	0.4956	0.7835	0.9604	0.9922	0.9971	(94)
Useful gains	470.6160	544.1708	620.7324	677.7332	645.0818	483.7864	323.4325	338.3126	480.1711	502.9476	458.9157	445.0921	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.5016	1305.3554	1186.2018	992.2814	764.5404	506.3037	326.4608	343.7277	547.2975	829.8296	1103.3045	1336.6943	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating												3269.0044	(98)
Space heating per m2											(98) / (4) =	40.9752	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3500.0047	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	696.9110	547.6618	450.4382	242.4783	95.1577	0.0000	0.0000	0.0000	0.0000	260.3857	496.7451	710.2270	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7850	87.5653	87.0623	85.8702	83.6596	80.3000	80.3000	80.3000	80.3000	85.9298	87.2930	87.8671	(217)
Fuel for water heating, kWh/month													
	230.1120	202.4549	211.8581	190.5162	189.3271	173.7253	166.4421	185.5439	187.5930	199.6169	209.7595	224.4729	(219)
Water heating fuel used												2371.4221	(219)
Annual totals kWh/year													
Space heating fuel - main system												3500.0047	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6303.3394	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3500.0047	0.2160	756.0010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.4221	0.2160	512.2272	(264)
Space and water heating			1268.2282	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1492.3908	(272)
Emissions per m2 for space and water heating			15.8966	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8966 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.7100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.3785	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3501	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4464	0.4376	0.4289	0.3851	0.3763	0.3326	0.3326	0.3238	0.3501	0.3763	0.3938	0.4113	(22b)
Effective ac	0.5996	0.5957	0.5920	0.5741	0.5708	0.5553	0.5553	0.5524	0.5613	0.5708	0.5776	0.5846	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.8077	40.5444	40.2864	39.0744	38.8476	37.7920	37.7920	37.5965	38.1986	38.8476	39.3064	39.7859	(38)
Heat transfer coeff	96.6893	96.4261	96.1680	94.9560	94.7292	93.6736	93.6736	93.4781	94.0802	94.7292	95.1880	95.6676	(39)
Average = Sum(39)m / 12 =												94.9549	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2119	1.2086	1.2054	1.1902	1.1874	1.1741	1.1741	1.1717	1.1792	1.1874	1.1931	1.1991	(40)
HLP (average)												1.1902	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	441.5784	531.4431	635.5241	748.3146	821.4770	813.0195	775.5536	709.3885	625.1809	515.3254	437.1418	413.9621	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5715	34.6659	34.7589	35.2025	35.2868	35.6845	35.6845	35.7591	35.5302	35.2868	35.1168	34.9407	
alpha	3.3048	3.3111	3.3173	3.3468	3.3525	3.3790	3.3790	3.3839	3.3687	3.3525	3.3411	3.3294	
util living area													
	0.9900	0.9809	0.9584	0.9017	0.7964	0.6435	0.5001	0.5568	0.7854	0.9422	0.9833	0.9919	(86)
MIT	19.0132	19.2587	19.6727	20.1954	20.6149	20.8699	20.9585	20.9403	20.7309	20.1516	19.4854	18.9743	(87)
Th 2	19.9105	19.9131	19.9157	19.9278	19.9301	19.9407	19.9407	19.9427	19.9366	19.9301	19.9255	19.9207	(88)
util rest of house													
	0.9878	0.9768	0.9492	0.8793	0.7497	0.5632	0.3921	0.4472	0.7188	0.9244	0.9790	0.9901	(89)
MIT 2	18.0998	18.3451	18.7547	19.2675	19.6520	19.8686	19.9256	19.9190	19.7669	19.2382	18.5811	18.0685	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2884	18.5338	18.9443	19.4591	19.8509	20.0754	20.1390	20.1300	19.9660	19.4269	18.7679	18.2556	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2884	18.5338	18.9443	19.4591	19.8509	20.0754	20.1390	20.1300	19.9660	19.4269	18.7679	18.2556	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9697	0.9385	0.8676	0.7458	0.5742	0.4133	0.4679	0.7209	0.9138	0.9726	0.9862	(94)
Useful gains	434.1602	515.3387	596.4700	649.2457	612.6854	466.8547	320.5024	331.8979	450.6757	470.8948	425.1734	408.2562	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1352.5328	1314.6531	1196.7452	1002.6547	772.1319	512.9011	331.5108	348.6704	551.8763	836.1654	1110.6482	1344.6662	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	683.2692	537.1393	446.6048	254.4545	118.6282	0.0000	0.0000	0.0000	0.0000	271.7614	493.5419	696.6891	(98)
Space heating												3502.0882	(98)
Space heating per m2											(98) / (4) =	43.8968	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	880.5319	693.1847	710.4337	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8319	0.8878	0.8602	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	732.4917	615.4322	611.0986	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1042.2160	996.5510	920.8390	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	223.0015	283.5524	230.4468	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												737.0007	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.7504	70.8881	57.6117	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												184.2502	(107)
Space cooling per m2												2.3095	(108)
Energy for space heating												43.8968	(99)
Energy for space cooling												2.3095	(108)
Total												46.2063	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	427.9478	505.2996	593.4688	688.0993	748.3884	738.4467	704.4605	647.8968	576.6729	484.5933	420.2468	402.6847	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9970	0.9906	0.9643	0.8855	0.7247	0.5557	0.6199	0.8706	0.9836	0.9975	0.9991	(86)
MIT	19.6511	19.8115	20.0908	20.4609	20.7676	20.9415	20.9876	20.9791	20.8452	20.4293	19.9743	19.6291	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9960	0.9871	0.9503	0.8414	0.6329	0.4326	0.4940	0.8037	0.9749	0.9964	0.9988	(89)
MIT 2	18.7000	18.8623	19.1420	19.5138	19.7950	19.9372	19.9609	19.9602	19.8718	19.4906	19.0360	18.6870	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9844	0.9463	0.8435	0.6502	0.4582	0.5202	0.8123	0.9719	0.9954	0.9984	(94)
Useful gains	427.0023	502.6483	584.2200	651.1352	631.2473	480.1137	322.8104	337.0254	468.4464	470.9619	418.2956	402.0272	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7863	1336.2379	1208.0068	1002.8277	767.5815	506.6286	326.4703	343.7342	548.4112	840.5503	1128.3900	1373.4673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.3593	560.1722	464.0973	253.2186	101.4326	0.0000	0.0000	0.0000	0.0000	274.9738	511.2679	722.7515	(98)
Space heating												3598.2733	(98)
Space heating per m2											(98) / (4) =	45.1024	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8754	0.9319	0.9069	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	751.9115	630.1425	628.3249	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	955.0530	913.4552	848.9656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.2619	210.7847	164.1567	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												521.2033	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   36.5655   52.6962   41.0392    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        130.3008 (107)
Space cooling per m2                                                                                                   1.6333 (108)
Energy for space heating                                                                                              45.1024 (99)
Energy for space cooling                                                                                               1.6333 (108)
Total                                                                                                                 46.7357 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   53.7 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b)	= 101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c)	= 104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.6387	206.7456	334.7707	480.9270	553.6537	613.1657	580.1500	514.9947	407.3959	262.1191	156.4787	102.9749	(83)
Total gains	680.6311	756.3355	862.9802	976.0236	1014.8767	1044.0538	993.3226	936.4486	847.9192	735.9668	667.3433	641.8169	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9621	0.9463	0.9028	0.8105	0.6744	0.4871	0.3616	0.3811	0.6181	0.8436	0.9376	0.9668	(86)
MIT	19.4990	19.6849	20.0608	20.4940	20.7954	20.9493	20.9860	20.9837	20.8867	20.5141	19.9695	19.4861	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9545	0.9359	0.8838	0.7749	0.6152	0.4057	0.2665	0.2818	0.5369	0.8043	0.9231	0.9600	(89)
MIT 2	17.9649	18.2350	18.7631	19.3547	19.7332	19.8980	19.9295	19.9308	19.8502	19.4001	18.6532	17.9556	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2818	18.5345	19.0312	19.5900	19.9526	20.1152	20.1477	20.1483	20.0643	19.6302	18.9251	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1318	18.3845	18.8812	19.4400	19.8026	19.9652	19.9977	19.9983	19.9143	19.4802	18.7751	18.1218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8611	0.7561	0.6075	0.4083	0.2722	0.2876	0.5347	0.7844	0.9024	0.9440	(94)
Useful gains	637.8826	692.7918	743.1078	738.0159	616.5560	426.2567	270.4176	269.3442	453.4138	577.2912	602.1916	605.8506	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1267.0984	1242.4405	1131.2944	941.3168	691.5535	440.6320	272.9898	272.3618	488.8118	763.1870	1021.9717	1239.3659	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	468.1366	369.3639	288.8109	146.3767	55.7981	0.0000	0.0000	0.0000	0.0000	138.3065	302.2417	471.3354	(98)
Space heating												2240.3697	(98)
RHI space heating demand												2240	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.4270	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9698	0.9537	0.9193	0.8450	0.7259	0.5672	0.4302	0.4740	0.6921	0.8837	0.9541	0.9739	(86)
MIT	19.3029	19.5307	19.9046	20.3643	20.7098	20.9094	20.9728	20.9623	20.8179	20.3539	19.7542	19.2674	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9637	0.9446	0.9033	0.8145	0.6734	0.4888	0.3326	0.3741	0.6180	0.8535	0.9434	0.9686	(89)
MIT 2	17.6647	17.9935	18.5266	19.1713	19.6203	19.8597	19.9165	19.9121	19.7666	19.1761	18.3299	17.6219	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0031	18.3110	18.8113	19.4177	19.8453	20.0765	20.1347	20.1290	19.9837	19.4194	18.6241	17.9618	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8531	18.1610	18.6613	19.2677	19.6953	19.9265	19.9847	19.9790	19.8337	19.2694	18.4741	17.8118	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9252	0.8804	0.7932	0.6615	0.4885	0.3378	0.3786	0.6110	0.8312	0.9243	0.9543	(94)
Useful gains	619.3304	684.8327	734.9287	740.8830	657.5865	476.0668	314.5988	329.2601	485.2101	580.1040	586.0175	592.6414	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1335.4946	1302.2696	1190.2767	998.7430	767.8986	504.4211	320.5338	338.0428	545.9511	832.6360	1099.0449	1323.5799	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	532.8261	414.9176	338.7789	185.6592	82.0722	0.0000	0.0000	0.0000	0.0000	187.8838	369.3797	543.8182	(98)
Space heating												2655.3358	(98)
Space heating per m2											(98) / (4) =	33.2832	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2934.0727	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.8261	414.9176	338.7789	185.6592	82.0722	0.0000	0.0000	0.0000	0.0000	187.8838	369.3797	543.8182	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	588.7581	458.4725	374.3413	205.1483	90.6875	0.0000	0.0000	0.0000	0.0000	207.6064	408.1544	600.9041	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7218	89.6497	89.4915	89.1397	88.5227	87.3000	87.3000	87.3000	87.3000	89.1199	89.5594	89.7507	(217)
Fuel for water heating, kWh/month													
	184.0845	161.5636	168.0448	148.5521	144.6314	128.1956	120.4190	135.8687	136.8056	154.2174	165.6255	178.7022	(219)
Water heating fuel used												1826.7103	(219)
Annual totals kWh/year													
Space heating fuel - main system												2934.0727	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) =										-1074.8994		-1074.8994	(233)
Total delivered energy for all uses												4117.7962	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2934.0727	3.4800	102.1057	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.7103	3.4800	63.5695	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			200.8653	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6761	(257)
SAP value		90.5684	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2934.0727	0.2160	633.7597	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7103	0.2160	394.5694	(264)
Space and water heating			1028.3291	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			694.6190	(272)
CO2 emissions per m2			8.7100	(273)
EI value			92.5406	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.6387	206.7456	334.7707	480.9270	553.6537	613.1657	580.1500	514.9947	407.3959	262.1191	156.4787	102.9749	(83)
Total gains	680.6311	756.3355	862.9802	976.0236	1014.8767	1044.0538	993.3226	936.4486	847.9192	735.9668	667.3433	641.8169	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9621	0.9463	0.9028	0.8105	0.6744	0.4871	0.3616	0.3811	0.6181	0.8436	0.9376	0.9668	(86)
MIT	19.4990	19.6849	20.0608	20.4940	20.7954	20.9493	20.9860	20.9837	20.8867	20.5141	19.9695	19.4861	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9545	0.9359	0.8838	0.7749	0.6152	0.4057	0.2665	0.2818	0.5369	0.8043	0.9231	0.9600	(89)
MIT 2	17.9649	18.2350	18.7631	19.3547	19.7332	19.8980	19.9295	19.9308	19.8502	19.4001	18.6532	17.9556	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2818	18.5345	19.0312	19.5900	19.9526	20.1152	20.1477	20.1483	20.0643	19.6302	18.9251	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1318	18.3845	18.8812	19.4400	19.8026	19.9652	19.9977	19.9983	19.9143	19.4802	18.7751	18.1218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8611	0.7561	0.6075	0.4083	0.2722	0.2876	0.5347	0.7844	0.9024	0.9440	(94)
Useful gains	637.8826	692.7918	743.1078	738.0159	616.5560	426.2567	270.4176	269.3442	453.4138	577.2912	602.1916	605.8506	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1267.0984	1242.4405	1131.2944	941.3168	691.5535	440.6320	272.9898	272.3618	488.8118	763.1870	1021.9717	1239.3659	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	468.1366	369.3639	288.8109	146.3767	55.7981	0.0000	0.0000	0.0000	0.0000	138.3065	302.2417	471.3354	(98)
Space heating												2240.3697	(98)
Space heating per m2											(98) / (4) =	28.0818	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2475.5466	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	468.1366	369.3639	288.8109	146.3767	55.7981	0.0000	0.0000	0.0000	0.0000	138.3065	302.2417	471.3354	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	517.2780	408.1369	319.1281	161.7422	61.6554	0.0000	0.0000	0.0000	0.0000	152.8249	333.9687	520.8126	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6430	89.5751	89.3782	88.9514	88.2471	87.3000	87.3000	87.3000	87.3000	88.8762	89.4209	89.6655	(217)
Fuel for water heating, kWh/month													
	184.2462	161.6980	168.2579	148.8667	145.0831	128.1956	120.4190	135.8687	136.8056	154.6402	165.8820	178.8719	(219)
Water heating fuel used												1828.8348	(219)
Annual totals kWh/year													
Space heating fuel - main system												2475.5466	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												3515.5695	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2475.5466	9.7400	241.1182	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.8348	9.7400	178.1285	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			232.5695	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2475.5466	0.2160	534.7181	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8348	0.2160	395.0283	(264)
Space and water heating			929.7464	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			520.3530	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2475.5466	1.2200	3020.1669	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8348	1.2200	2231.1785	(264)
Space and water heating			5251.3454	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			2829.6925	(272)
Primary energy kWh/m2/year			35.4687	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 77	-185 kg (35.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.32 kg/m²	A 92	A 94
Total Savings	£77	2.32 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£159	£178	-£18
Mains gas	£523	£428	£95
Space heating	£373	£373	£0
Water heating	£178	£101	£77
Lighting	£132	£132	£0
Generated (PV)	-£450	-£450	£0
Total cost of fuels	£232	£156	£77
Total cost of uses	£233	£156	£77
Delivered energy	44 kWh/m²	32 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	4 kg/m²	2 kg/m²
Primary energy	35 kWh/m²	22 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.6600	
Infiltration rate		0.4270	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5035	0.4937	0.4838	0.4344	0.4246	0.3752	0.3752	0.3653	0.3949	0.4246	0.4443	0.4640	(22b)
Effective ac	0.6268	0.6219	0.6170	0.5944	0.5901	0.5704	0.5704	0.5667	0.5780	0.5901	0.5987	0.6077	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.6562	42.3211	41.9927	40.4502	40.1616	38.8182	38.8182	38.5694	39.3357	40.1616	40.7455	41.3558	(38)
Heat transfer coeff	98.5378	98.2028	97.8744	96.3319	96.0433	94.6998	94.6998	94.4510	95.2173	96.0433	96.6271	97.2375	(39)
Average = Sum(39)m / 12 =												96.3305	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2351	1.2309	1.2268	1.2075	1.2039	1.1870	1.1870	1.1839	1.1935	1.2039	1.2112	1.2188	(40)
HLP (average)												1.2075	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.9230	34.0387	34.1529	34.6998	34.8040	35.2978	35.2978	35.3908	35.1059	34.8040	34.5937	34.3766	
alpha	3.2615	3.2692	3.2769	3.3133	3.3203	3.3532	3.3532	3.3594	3.3404	3.3203	3.3062	3.2918	
util living area													
	0.9698	0.9537	0.9193	0.8450	0.7259	0.5672	0.4302	0.4740	0.6921	0.8837	0.9541	0.9739	(86)
MIT	19.3029	19.5307	19.9046	20.3643	20.7098	20.9094	20.9728	20.9623	20.8179	20.3539	19.7542	19.2674	(87)
Th 2	19.8920	19.8953	19.8986	19.9140	19.9169	19.9304	19.9304	19.9329	19.9252	19.9169	19.9111	19.9050	(88)
util rest of house													
	0.9637	0.9446	0.9033	0.8145	0.6734	0.4888	0.3326	0.3741	0.6180	0.8535	0.9434	0.9686	(89)
MIT 2	17.6647	17.9935	18.5266	19.1713	19.6203	19.8597	19.9165	19.9121	19.7666	19.1761	18.3299	17.6219	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0031	18.3110	18.8113	19.4177	19.8453	20.0765	20.1347	20.1290	19.9837	19.4194	18.6241	17.9618	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8531	18.1610	18.6613	19.2677	19.6953	19.9265	19.9847	19.9790	19.8337	19.2694	18.4741	17.8118	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9252	0.8804	0.7932	0.6615	0.4885	0.3378	0.3786	0.6110	0.8312	0.9243	0.9543	(94)
Useful gains	619.3304	684.8327	734.9287	740.8830	657.5865	476.0668	314.5988	329.2601	485.2101	580.1040	586.0175	592.6414	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1335.4946	1302.2696	1190.2767	998.7430	767.8986	504.4211	320.5338	338.0428	545.9511	832.6360	1099.0449	1323.5799	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	532.8261	414.9176	338.7789	185.6592	82.0722	0.0000	0.0000	0.0000	0.0000	187.8838	369.3797	543.8182	(98)

Space heating 2655.3358 (98)
Space heating per m2 (98) / (4) = 33.2832 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2934.0727 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	532.8261	414.9176	338.7789	185.6592	82.0722	0.0000	0.0000	0.0000	0.0000	187.8838	369.3797	543.8182	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	588.7581	458.4725	374.3413	205.1483	90.6875	0.0000	0.0000	0.0000	0.0000	207.6064	408.1544	600.9041	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8123	89.8399	89.8652	89.9246	90.0502	87.3000	87.3000	87.3000	87.3000	89.4762	89.6972	89.8262	(217)
Fuel for water heating, kWh/month	156.6681	115.7948	90.0009	43.6663	14.3807	0.0000	0.0000	24.1300	49.2919	95.2953	133.0297	155.7678	(219)

Water heating fuel used 878.0255 (219)
Annual totals kWh/year
Space heating fuel - main system 2934.0727 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 908 * 1.00) = -1074.8994 -1074.8994 (233)
Total delivered energy for all uses 3219.1114 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2934.0727	3.4800	102.1057	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.0255	3.4800	30.5553	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1074.8994	13.1900	-141.7792	(252)
Total energy cost			174.4461	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.5872 (257)
SAP value 91.8089
SAP rating (Section 12) 92 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2934.0727	0.2160	633.7597	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.0255	0.2160	189.6535	(264)
Space and water heating			823.4132	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1074.8994	0.5190	-557.8728	(269)
Total kg/year			515.6531	(272)
CO2 emissions per m2			6.4600	(273)
EI value			94.4625	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.6600	
Infiltration rate			0.4270	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3949	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4147	0.3851	0.3949	0.3752	0.3752	0.3653	0.3554	0.3456	0.3357	0.3653	0.3456	0.3653	(22b)
Effective ac	0.5860	0.5741	0.5780	0.5704	0.5704	0.5667	0.5632	0.5597	0.5563	0.5667	0.5597	0.5667	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8797	39.0736	39.3357	38.8182	38.8182	38.5694	38.3272	38.0917	37.8628	38.5694	38.0917	38.5694	(38)
Heat transfer coeff	95.7613	94.9552	95.2173	94.6998	94.6998	94.4510	94.2089	93.9734	93.7445	94.4510	93.9734	94.4510	(39)
Average = Sum(39)m / 12 =												94.5489	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2003	1.1902	1.1935	1.1870	1.1870	1.1839	1.1809	1.1779	1.1750	1.1839	1.1779	1.1839	(40)
HLP (average)												1.1851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	25.1925	0.4600	0.0000	0.7700	45.1514	(76)
South	0.7200	56.7559	0.4600	0.0000	0.7700	14.4741	(78)
West	3.0000	25.1925	0.4600	0.0000	0.7700	26.7696	(80)
West	4.5100	25.1925	0.4600	0.0000	0.7700	40.2436	(80)

Solar gains	126.6387	206.7456	334.7707	480.9270	553.6537	613.1657	580.1500	514.9947	407.3959	262.1191	156.4787	102.9749	(83)
Total gains	680.6311	756.3355	862.9802	976.0236	1014.8767	1044.0538	993.3226	936.4486	847.9192	735.9668	667.3433	641.8169	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.9065	35.2028	35.1059	35.2978	35.2978	35.3908	35.4817	35.5707	35.6575	35.3908	35.5707	35.3908	
alpha	3.3271	3.3469	3.3404	3.3532	3.3532	3.3594	3.3654	3.3714	3.3772	3.3594	3.3714	3.3594	
util living area													
	0.9621	0.9463	0.9028	0.8105	0.6744	0.4871	0.3616	0.3811	0.6181	0.8436	0.9376	0.9668	(86)
MIT	19.4990	19.6849	20.0608	20.4940	20.7954	20.9493	20.9860	20.9837	20.8867	20.5141	19.9695	19.4861	(87)
Th 2	19.9197	19.9278	19.9252	19.9304	19.9304	19.9329	19.9353	19.9377	19.9400	19.9329	19.9377	19.9329	(88)
util rest of house													
	0.9545	0.9359	0.8838	0.7749	0.6152	0.4057	0.2665	0.2818	0.5369	0.8043	0.9231	0.9600	(89)
MIT 2	17.9649	18.2350	18.7631	19.3547	19.7332	19.8980	19.9295	19.9308	19.8502	19.4001	18.6532	17.9556	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2818	18.5345	19.0312	19.5900	19.9526	20.1152	20.1477	20.1483	20.0643	19.6302	18.9251	18.2718	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1318	18.3845	18.8812	19.4400	19.8026	19.9652	19.9977	19.9983	19.9143	19.4802	18.7751	18.1218	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8611	0.7561	0.6075	0.4083	0.2722	0.2876	0.5347	0.7844	0.9024	0.9440	(94)
Useful gains	637.8826	692.7918	743.1078	738.0159	616.5560	426.2567	270.4176	269.3442	453.4138	577.2912	602.1916	605.8506	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1267.0984	1242.4405	1131.2944	941.3168	691.5535	440.6320	272.9898	272.3618	488.8118	763.1870	1021.9717	1239.3659	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	468.1366	369.3639	288.8109	146.3767	55.7981	0.0000	0.0000	0.0000	0.0000	138.3065	302.2417	471.3354	(98)
Space heating												2240.3697	(98)
Space heating per m2											(98) / (4) =	28.0818	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2475.5466	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	468.1366	369.3639	288.8109	146.3767	55.7981	0.0000	0.0000	0.0000	0.0000	138.3065	302.2417	471.3354	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	517.2780	408.1369	319.1281	161.7422	61.6554	0.0000	0.0000	0.0000	0.0000	152.8249	333.9687	520.8126	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7568	89.7758	89.7821	89.8181	89.7179	87.3000	87.3000	87.3000	87.3000	89.2875	89.5974	89.7595	(217)
Fuel for water heating, kWh/month	152.1912	116.0982	89.7524	42.5714	19.4041	0.0000	0.0000	17.2721	43.9527	91.1616	127.8520	152.5191	(219)
Water heating fuel used												852.7747	(219)
Annual totals kWh/year													
Space heating fuel - main system												2475.5466	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1031 * 1.00) =										-1220.7247		-1220.7247	(233)
Total delivered energy for all uses												2589.5093	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2475.5466	9.7400	241.1182	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.7747	9.7400	83.0603	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	356.9126	36.8500	131.5223	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1220.7247	36.8500	-449.8370	(252)
Total energy cost			155.9263	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2475.5466	0.2160	534.7181	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7747	0.2160	184.1993	(264)
Space and water heating			718.9174	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1220.7247	0.5190	-633.5561	(269)
Total kg/year			335.4740	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2475.5466	1.2200	3020.1669	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7747	1.2200	1040.3851	(264)
Space and water heating			4060.5520	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1220.7247	3.0700	-3747.6247	(269)
Primary energy kWh/year			1792.3992	(272)
Primary energy kWh/m2/year			22.4668	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						644.9508

	Jun	Jul	Aug	
Solar gains	684	645	571	(P4)
Internal gains	428	410	418	
Total summer gains	1112	1055	989	(P5)
Summer gain/loss ratio	3.39	3.22	3.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.33	22.06	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-353	**Issued on Date**	28/04/2023
Assessment Reference	As Built	**Prop Type Ref**	Dawlish-As-DET
Property	3, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	90 B	**DER**	11.57	**TER**	19.04
Environmental	91 B	**% DER<TER**	39.24		
CO_2 Emissions (t/year)	0.75	**DFEE**	53.19	**TFEE**	61.24
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.15		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 97 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.04 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.57 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)61.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.61 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.28 m², No overhang
Windows facing East: 7.74 m², No overhang
Windows facing South: 5.95 m², No overhang
Windows facing West: 1.31 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5477	0.5370	0.5262	0.4725	0.4618	0.4081	0.4081	0.3974	0.4296	0.4618	0.4833	0.5048	(22b)
Effective ac	0.6500	0.6442	0.6385	0.6117	0.6066	0.5833	0.5833	0.5790	0.5923	0.6066	0.6168	0.6274	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8701	53.3874	52.9142	50.6917	50.2759	48.3401	48.3401	47.9817	49.0857	50.2759	51.1171	51.9965	(38)
Heat transfer coeff	138.5970	138.1142	137.6410	135.4185	135.0027	133.0669	133.0669	132.7085	133.8126	135.0027	135.8439	136.7233	(39)
Average = Sum(39)m / 12 =												135.4165	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4236	1.4186	1.4137	1.3909	1.3866	1.3668	1.3668	1.3631	1.3744	1.3866	1.3953	1.4043	(40)
HLP (average)												1.3909	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
                24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
                57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                22.4777    19.9645    16.2362    12.2919     9.1883     7.7572     8.3819    10.8951    14.6234    18.5677    21.6713    23.1024 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               251.9878   254.6027   248.0133   233.9854   216.2777   199.6350   188.5166   185.9018   192.4911   206.5190   224.2267   240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
                76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
               417.8424   415.6611   400.6028   376.1820   351.1829   327.2146   311.7142   318.0311   330.6319   355.2780   383.6216   405.0753 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	10.6334	0.4600	0.0000	0.7700	23.6527	(74)
East	7.7400	19.6403	0.4600	0.0000	0.7700	53.8439	(76)
South	2.6200	46.7521	0.4600	0.0000	0.7700	43.3861	(78)
West	1.3100	19.6403	0.4600	0.0000	0.7700	9.1131	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

```
Solar gains    185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains    602.9816   745.3858   885.7853  1027.6785  1121.9882  1109.2141  1058.7627   974.3658   873.5944   729.2693   608.0913   561.7048 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            34.9962    35.1185    35.2392    35.8176    35.9279    36.4506    36.4506    36.5490    36.2475    35.9279    35.7054    35.4758
alpha           3.3331     3.3412     3.3493     3.3878     3.3952     3.4300     3.4300     3.4366     3.4165     3.3952     3.3804     3.3651
util living area
                 0.9916     0.9826     0.9623     0.9119     0.8138     0.6634     0.5181     0.5729     0.7945     0.9449     0.9852     0.9934 (86)

MIT            18.9963    19.2575    19.6625    20.1753    20.5970    20.8631    20.9563    20.9381    20.7295    20.1587    19.4858    18.9616 (87)
Th 2           19.7453    19.7491    19.7528    19.7703    19.7736    19.7889    19.7889    19.7918    19.7830    19.7736    19.7670    19.7600 (88)
util rest of house
                 0.9894     0.9781     0.9522     0.8874     0.7612     0.5698     0.3902     0.4439     0.7173     0.9245     0.9806     0.9916 (89)
MIT 2          17.1056    17.4869    18.0725    18.8058    19.3669    19.6877    19.7695    19.7612    19.5516    18.8011    17.8325    17.0638 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.2028 (91)
MIT            17.4889    17.8459    18.3949    19.0835    19.6163    19.9261    20.0101    19.9999    19.7904    19.0763    18.1678    17.4486 (92)
Temperature adjustment                                                                                                              -0.1500
adjusted MIT   17.3389    17.6959    18.2449    18.9335    19.4663    19.7761    19.8601    19.8499    19.6404    18.9263    18.0178    17.2986 (93)
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8. Space heating requirement

```
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9827     0.9669     0.9350     0.8661     0.7456     0.5687     0.3982     0.4506     0.7064     0.9050     0.9704     0.9860 (94)
Useful gains   592.5368   720.7184   828.1869   890.0348   836.5911   630.8179   421.5736   439.0630   617.1467   659.9709   590.1128   553.8648 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1807.1549  1767.2892  1616.5812  1358.7190  1048.4755   688.7618   433.8093   457.8258   741.3817  1124.0788  1483.1099  1790.8833 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               903.6758   703.2956   586.5654   337.4527   157.6419     0.0000     0.0000     0.0000     0.0000   345.2962   642.9579   920.3418 (98)
Space heating                                                                                                                      4597.2274 (98)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 47.2189 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5079.8092 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	903.6758	703.2956	586.5654	337.4527	157.6419	0.0000	0.0000	0.0000	0.0000	345.2962	642.9579	920.3418	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	998.5368	777.1222	648.1385	372.8759	174.1900	0.0000	0.0000	0.0000	0.0000	381.5428	710.4507	1016.9522	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9648	89.9095	89.7969	89.5365	88.9920	87.3000	87.3000	87.3000	87.3000	89.5269	89.8530	89.9858	(217)
Fuel for water heating, kWh/month	194.5963	170.7377	177.4481	156.6158	152.2872	135.5997	127.2799	143.7432	144.7757	162.5730	174.9212	188.8946	(219)
Water heating fuel used												1929.4724	(219)

Annual totals kWh/year
Space heating fuel - main system 5079.8092 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 396.9635 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 6262.6881 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5079.8092	0.2160	1097.2388	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.4724	0.2160	416.7660	(264)
Space and water heating			1514.0048	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1126.5228	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.5700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		11.5700	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		28.7984	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7984	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3695	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 50.9589 46.0274 50.9589 47.6766 47.2549 43.7846 45.2441 47.2549 47.6766 50.9589 49.3151 50.9589 (61)
Total heat required for water heating calculated for each month
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (64)
Total per year (kWh/year) = Sum(64)m = 2130.2265 (64)
Heat gains from water heating, kWh/month
66.2474 58.3050 61.0313 54.0209 52.2113 45.8062 43.6140 48.8819 49.4300 56.4550 60.0474 64.5591 (65)

---

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9200	10.6334	0.6300	0.7000	0.7700	19.2382	(74)
East	7.3100	19.6403	0.6300	0.7000	0.7700	43.8770	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	1.2400	19.6403	0.6300	0.7000	0.7700	7.4429	(80)

Solar gains	150.8569	268.6665	395.3241	530.8075	627.9843	637.0900	608.6217	534.7384	442.3942	304.7329	182.9041	127.6264	(83)
Total gains	581.1494	696.7729	808.3676	918.8627	990.3649	974.8348	930.8763	863.9807	784.9186	672.4710	578.9831	545.1582	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9980	0.9951	0.9867	0.9588	0.8831	0.7326	0.5687	0.6270	0.8593	0.9766	0.9958	0.9985	(86)
MIT	19.5255	19.7084	20.0028	20.3862	20.7161	20.9185	20.9801	20.9693	20.8188	20.3808	19.8827	19.4981	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9973	0.9933	0.9818	0.9425	0.8360	0.6340	0.4317	0.4889	0.7853	0.9643	0.9940	0.9980	(89)
MIT 2	17.8681	18.1369	18.5662	19.1213	19.5626	19.7984	19.8454	19.8422	19.7020	19.1243	18.4014	17.8356	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.2041	18.4555	18.8574	19.3778	19.7965	20.0255	20.0754	20.0707	19.9285	19.3791	18.7017	18.1727	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2041	18.4555	18.8574	19.3778	19.7965	20.0255	20.0754	20.0707	19.9285	19.3791	18.7017	18.1727	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9903	0.9760	0.9340	0.8339	0.6503	0.4596	0.5167	0.7915	0.9574	0.9913	0.9968	(94)
Useful gains	578.6637	690.0195	788.9812	858.2502	825.8381	633.9755	427.7902	446.4147	621.2721	643.8461	573.9417	543.3951	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1796.6422	1746.7505	1588.0461	1329.2690	1024.6760	678.8723	434.8679	458.3319	732.5060	1111.0611	1475.5081	1786.1340	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	906.1760	710.1232	594.5042	339.1335	147.9354	0.0000	0.0000	0.0000	0.0000	347.6079	649.1278	924.5978	(98)
Space heating												4619.2059	(98)
Space heating per m2											(98) / (4) =	47.4446	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4945.6166	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	906.1760	710.1232	594.5042	339.1335	147.9354	0.0000	0.0000	0.0000	0.0000	347.6079	649.1278	924.5978	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	970.2098	760.3032	636.5142	363.0980	158.3891	0.0000	0.0000	0.0000	0.0000	372.1712	694.9976	989.9334	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2954	88.0926	87.6641	86.6981	84.7217	80.3000	80.3000	80.3000	80.3000	86.6489	87.8688	88.3683	(217)
Fuel for water heating, kWh/month													
	239.9722	212.0198	223.8051	201.0405	199.1833	185.0896	177.3299	197.6813	199.8645	210.5434	219.4519	234.0279	(219)
Water heating fuel used												2500.0094	(219)
Annual totals kWh/year													
Space heating fuel - main system												4945.6166	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												7918.9870	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4945.6166	0.2160	1068.2532	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2500.0094	0.2160	540.0020	(264)
Space and water heating			1608.2552	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1853.9296	(272)
Emissions per m2 for space and water heating			16.5186	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5186 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			19.0400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.3500	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4462	0.4374	0.4287	0.3849	0.3762	0.3325	0.3325	0.3237	0.3500	0.3762	0.3937	0.4112	(22b)
Effective ac	0.5995	0.5957	0.5919	0.5741	0.5708	0.5553	0.5553	0.5524	0.5612	0.5708	0.5775	0.5845	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6882	49.3679	49.0539	47.5790	47.3030	46.0184	46.0184	45.7806	46.5132	47.3030	47.8613	48.4449	(38)
Heat transfer coeff	134.4150	134.0947	133.7807	132.3058	132.0298	130.7453	130.7453	130.5074	131.2401	132.0298	132.5881	133.1717	(39)
Average = Sum(39)m / 12 =												132.3045	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3806	1.3773	1.3741	1.3589	1.3561	1.3429	1.3429	1.3405	1.3480	1.3561	1.3618	1.3678	(40)
HLP (average)												1.3589	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Heat gains from water heating, kWh/month
               34.1967    29.9086    30.8630    26.9071    25.8180    22.2790    20.6448    23.6902    23.9731    27.9383    30.4969    33.1176 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               22.4777    19.9645    16.2362    12.2919     9.1883     7.7572     8.3819    10.8951    14.6234    18.5677    21.6713    23.1024 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              251.9878   254.6027   248.0133   233.9854   216.2777   199.6350   188.5166   185.9018   192.4911   206.5190   224.2267   240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               45.9632    44.5069    41.4825    37.3710    34.7016    30.9430    27.7483    31.8416    33.2960    37.5515    42.3568    44.5130 (72)
Total internal gains
              384.1344   382.7796   369.4377   347.3539   323.8733   302.0408   288.3524   292.3441   304.1161   326.3439   351.9604   372.1904 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g              FF          Access           Gains
                                           m2          Table 6a      Specific data  Specific data      factor               W
                                                          W/m2        or Table 6b    or Table 6c     Table 6d
-------------------------------------------------------------------------------------------------------------
North                                  6.2800           10.6334            0.4600          0.0000          0.7700          23.6527 (74)
East                                   7.7400           19.6403            0.4600          0.0000          0.7700          53.8439 (76)
South                                  2.6200           46.7521            0.4600          0.0000          0.7700          43.3861 (78)
West                                   1.3100           19.6403            0.4600          0.0000          0.7700           9.1131 (80)
South                                  3.3300           46.7521            0.4600          0.0000          0.7700          55.1434 (78)
-------------------------------------------------------------------------------------------------------------

Solar gains    185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains    569.2736   712.5044   854.6202   998.8504  1094.6786  1084.0403  1035.4010   948.6788   847.0786   700.3352   576.4301   528.8198 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.0850    36.1712    36.2561    36.6603    36.7369    37.0978    37.0978    37.1655    36.9580    36.7369    36.5822    36.4219
alpha          3.4057     3.4114     3.4171     3.4440     3.4491     3.4732     3.4732     3.4777     3.4639     3.4491     3.4388     3.4281
util living area
               0.9930     0.9846     0.9651     0.9155     0.8175     0.6675     0.5210     0.5785     0.8011     0.9494     0.9873     0.9946 (86)

MIT           19.0209    19.2814    19.6841    20.1872    20.6055    20.8654    20.9575    20.9387    20.7306    20.1609    19.4926    18.9776 (87)
Th 2          19.7782    19.7808    19.7833    19.7950    19.7972    19.8074    19.8074    19.8093    19.8034    19.7972    19.7927    19.7881 (88)
util rest of house
               0.9912     0.9806     0.9557     0.8920     0.7660     0.5750     0.3944     0.4505     0.7258     0.9306     0.9833     0.9931 (89)
MIT 2         17.9915    18.2516    18.6500    19.1432    19.5240    19.7390    19.7943    19.7884    19.6447    19.1306    18.4720    17.9555 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.2028 (91)
MIT           18.2002    18.4604    18.8597    19.3548    19.7432    19.9674    20.0301    20.0216    19.8649    19.3395    18.6789    18.1627 (92)
Temperature adjustment                                                                                               0.0000
adjusted MIT  18.2002    18.4604    18.8597    19.3548    19.7432    19.9674    20.0301    20.0216    19.8649    19.3395    18.6789    18.1627 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9878     0.9747     0.9464     0.8816     0.7633     0.5885     0.4194     0.4750     0.7303     0.9212     0.9782     0.9904 (94)
Useful gains  562.3235   694.4851   808.8465   880.5697   835.5982   637.9961   434.2326   450.6499   618.6070   645.1703   563.8701   523.7192 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1868.3965  1818.3746  1653.4878  1383.2364  1061.9472   701.7626   448.4746   472.6481   756.5823  1153.8715  1535.2296  1859.4430 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              971.7183   755.2538   628.4131   361.9200   168.4037     0.0000     0.0000     0.0000     0.0000   378.4737   699.3788   993.7785 (98)
Space heating                                                                                                       4957.3401 (98)
Space heating per m2                                                                                 (98) / (4) =     50.9176 (99)


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8c. Space cooling requirement
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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1229.0055	967.5149	991.8561	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8167	0.8774	0.8473	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1003.7794	848.8624	840.3968	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1370.5941	1311.5148	1211.9592	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	264.1066	344.2134	276.4425	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												884.7625	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.0266	86.0534	69.1106	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												221.1906	(107)
Space cooling per m2												2.2719	(108)
Energy for space heating												50.9176	(99)
Energy for space cooling												2.2719	(108)
Total												53.1895	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9200	10.6334	0.6300	0.7000	0.7700	19.2382	(74)
East	7.3100	19.6403	0.6300	0.7000	0.7700	43.8770	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	1.2400	19.6403	0.6300	0.7000	0.7700	7.4429	(80)

Solar gains	150.8569	268.6665	395.3241	530.8075	627.9843	637.0900	608.6217	534.7384	442.3942	304.7329	182.9041	127.6264	(83)
Total gains	535.0704	651.5164	764.8189	878.2047	951.8900	939.1581	897.0036	827.1209	746.5618	631.1421	534.9407	499.8982	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9986	0.9962	0.9893	0.9648	0.8952	0.7505	0.5870	0.6490	0.8765	0.9815	0.9969	0.9990	(86)
MIT	19.4828	19.6670	19.9644	20.3545	20.6949	20.9097	20.9774	20.9647	20.7999	20.3458	19.8421	19.4560	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9980	0.9949	0.9852	0.9504	0.8511	0.6528	0.4471	0.5088	0.8072	0.9715	0.9956	0.9986	(89)
MIT 2	18.4447	18.6305	18.9280	19.3194	19.6342	19.8109	19.8469	19.8447	19.7354	19.3185	18.8162	18.4265	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6551	18.8407	19.1382	19.5293	19.8492	20.0337	20.0761	20.0717	19.9512	19.5268	19.0242	18.6352	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6551	18.8407	19.1382	19.5293	19.8492	20.0337	20.0761	20.0717	19.9512	19.5268	19.0242	18.6352	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9933	0.9820	0.9455	0.8514	0.6699	0.4758	0.5374	0.8147	0.9677	0.9943	0.9980	(94)
Useful gains	533.6322	647.1642	751.0215	830.3150	810.4733	629.1508	426.7987	444.4907	608.2526	610.7774	531.8906	498.9099	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1854.9178	1796.3830	1624.1201	1348.4847	1031.3508	679.8953	434.9490	458.4584	735.3662	1129.7521	1516.5262	1845.2625	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	983.0365	772.2751	649.5853	373.0822	164.3328	0.0000	0.0000	0.0000	0.0000	386.1172	708.9376	1001.6863	(98)
Space heating												5039.0531	(98)
Space heating per m2											(98) / (4) =	51.7569	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8301	0.8977	0.8673	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	976.3096	831.2324	822.9787	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1201.2876	1149.7910	1069.9296	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	161.9842	237.0076	183.7315	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												582.7233 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	40.4961	59.2519	45.9329	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												145.6808 (107)
Space cooling per m2												1.4963 (108)
Energy for space heating												51.7569 (99)
Energy for space cooling												1.4963 (108)
Total												53.2532 (109)
Target Fabric Energy Efficiency (TFEE)												61.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4511	0.4189	0.4296	0.4081	0.4081	0.3974	0.3866	0.3759	0.3652	0.3974	0.3759	0.3974	(22b)
Effective ac	0.6017	0.5877	0.5923	0.5833	0.5833	0.5790	0.5747	0.5706	0.5667	0.5790	0.5706	0.5790	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8696	48.7082	49.0857	48.3401	48.3401	47.9817	47.6327	47.2934	46.9636	47.9817	47.2934	47.9817	(38)
Heat transfer coeff	134.5964	133.4350	133.8126	133.0669	133.0669	132.7085	132.3596	132.0202	131.6904	132.7085	132.0202	132.7085	(39)
Average = Sum(39)m / 12 =												132.8495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3825	1.3705	1.3744	1.3668	1.3668	1.3631	1.3595	1.3560	1.3526	1.3631	1.3560	1.3631	(40)
HLP (average)												1.3645	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306 (61)

Total heat required for water heating calculated for each month

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (64)
								Total per year (kWh/year) = Sum(64)m =				1717.7401 (64)

RHI water heating demand 1718 (64)

Heat gains from water heating, kWh/month

	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482 (71)

Water heating gains (Table 5)

	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979 (72)

Total internal gains

	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	13.4839	0.4600	0.0000	0.7700	29.9932	(74)
East	7.7400	25.1925	0.4600	0.0000	0.7700	69.0656	(76)
South	2.6200	56.7559	0.4600	0.0000	0.7700	52.6697	(78)
West	1.3100	25.1925	0.4600	0.0000	0.7700	11.6894	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	230.3606	349.8676	520.9835	707.2576	797.9519	880.4696	834.0926	749.0166	616.9653	428.7075	278.5314	191.4913 (83)
Total gains	850.5974	965.4412	1112.6609	1261.6885	1314.0066	1362.2121	1295.7956	1219.5184	1108.9058	958.1199	849.6644	794.4220 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.0364	36.3500	36.2475	36.4506	36.4506	36.5490	36.6454	36.7396	36.8316	36.5490	36.7396	36.5490	
alpha	3.4024	3.4233	3.4165	3.4300	3.4300	3.4366	3.4430	3.4493	3.4554	3.4366	3.4493	3.4366	
util living area	0.9744	0.9607	0.9239	0.8425	0.7131	0.5200	0.3881	0.4095	0.6529	0.8702	0.9542	0.9784	(86)
MIT	19.4237	19.6212	20.0024	20.4476	20.7706	20.9431	20.9843	20.9816	20.8747	20.4792	19.9115	19.4076	(87)
Th 2	19.7768	19.7860	19.7830	19.7889	19.7889	19.7918	19.7945	19.7972	19.7999	19.7918	19.7972	19.7918	(88)
util rest of house	0.9680	0.9513	0.9054	0.8048	0.6459	0.4228	0.2729	0.2890	0.5584	0.8290	0.9410	0.9729	(89)
MIT 2	17.7428	18.0310	18.5678	19.1765	19.5790	19.7569	19.7892	19.7909	19.7088	19.2383	18.4590	17.7297	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.0836	18.3534	18.8587	19.4343	19.8206	19.9974	20.0315	20.0323	19.9452	19.4899	18.7535	18.0699	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9336	18.2034	18.7087	19.2843	19.6706	19.8474	19.8815	19.8823	19.7952	19.3399	18.6035	17.9199	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9542	0.9343	0.8845	0.7863	0.6386	0.4276	0.2814	0.2978	0.5579	0.8099	0.9230	0.9605	(94)
Useful gains	811.6639	902.0060	984.1627	992.0330	839.1052	582.4322	364.6880	363.2150	618.7126	775.9987	784.2627	763.0812	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1754.2787	1721.7671	1566.7697	1301.9607	954.1760	603.4836	368.1626	367.3259	670.9848	1053.6945	1413.0775	1714.5805	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	701.3054	550.8795	433.4596	223.1480	85.6127	0.0000	0.0000	0.0000	0.0000	206.6056	452.7466	707.9155	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3361.6729 (98)
RHI space heating demand	3362 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5477	0.5370	0.5262	0.4725	0.4618	0.4081	0.4081	0.3974	0.4296	0.4618	0.4833	0.5048	(22b)
Effective ac	0.6500	0.6442	0.6385	0.6117	0.6066	0.5833	0.5833	0.5790	0.5923	0.6066	0.6168	0.6274	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8701	53.3874	52.9142	50.6917	50.2759	48.3401	48.3401	47.9817	49.0857	50.2759	51.1171	51.9965	(38)
Heat transfer coeff	138.5970	138.1142	137.6410	135.4185	135.0027	133.0669	133.0669	132.7085	133.8126	135.0027	135.8439	136.7233	(39)
Average = Sum(39)m / 12 =												135.4165	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4236	1.4186	1.4137	1.3909	1.3866	1.3668	1.3668	1.3631	1.3744	1.3866	1.3953	1.4043	(40)
HLP (average)												1.3909	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	10.6334	0.4600	0.0000	0.7700	23.6527	(74)
East	7.7400	19.6403	0.4600	0.0000	0.7700	53.8439	(76)
South	2.6200	46.7521	0.4600	0.0000	0.7700	43.3861	(78)
West	1.3100	19.6403	0.4600	0.0000	0.7700	9.1131	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

```
Solar gains   185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains   805.3760   945.2984  1076.8599  1205.9274  1286.8600  1263.7420  1208.7515  1126.8365  1034.9030   903.4037   795.6027   759.5601 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           34.9962    35.1185    35.2392    35.8176    35.9279    36.4506    36.4506    36.5490    36.2475    35.9279    35.7054    35.4758
alpha          3.3331     3.3412     3.3493     3.3878     3.3952     3.4300     3.4300     3.4366     3.4165     3.3952     3.3804     3.3651
util living area
                0.9805     0.9662     0.9374     0.8736     0.7629     0.6052     0.4627     0.5094     0.7276     0.9068     0.9681     0.9837 (86)

MIT           19.2200    19.4689    19.8462    20.3122    20.6778    20.8974    20.9691    20.9569    20.7990    20.3118    19.6868    19.1833 (87)
Th 2          19.7453    19.7491    19.7528    19.7703    19.7736    19.7889    19.7889    19.7918    19.7830    19.7736    19.7670    19.7600 (88)
util rest of house
                0.9757     0.9580     0.9220     0.8422     0.7046     0.5129     0.3447     0.3890     0.6434     0.8764     0.9590     0.9797 (89)
MIT 2         17.4290    17.7890    18.3286    18.9845    19.4578    19.7157    19.7756    19.7714    19.6194    19.0036    18.1193    17.3851 (90)
Living area fraction                                                                                        fLA = Living area / (4) =      0.2028 (91)
MIT           17.7921    18.1296    18.6363    19.2537    19.7052    19.9553    20.0176    20.0118    19.8586    19.2689    18.4371    17.7497 (92)
Temperature adjustment                                                                                                                  -0.1500
adjusted MIT  17.6421    17.9796    18.4863    19.1037    19.5552    19.8053    19.8676    19.8618    19.7086    19.1189    18.2871    17.5997 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9637     0.9417     0.9014     0.8215     0.6929     0.5142     0.3527     0.3964     0.6375     0.8555     0.9432     0.9691 (94)
Useful gains  776.1025   890.2196   970.6514   990.7293   891.6080   649.8741   426.3710   446.7066   659.7381   772.8483   750.4245   736.0793 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1849.1778  1806.4814  1649.8091  1381.7632  1060.4714   692.6493   434.8105   459.4068   750.5004  1150.0681  1519.7011  1832.0490 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              798.3680   615.7279   505.2934   281.5444   125.6344     0.0000     0.0000     0.0000     0.0000   280.6515   553.8792   815.4015 (98)
Space heating                                                                                                                        3976.5001 (98)
```

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Space heating per m2 (98) / (4) = 40.8433 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4393.9228 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	798.3680	615.7279	505.2934	281.5444	125.6344	0.0000	0.0000	0.0000	0.0000	280.6515	553.8792	815.4015	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	882.1746	680.3623	558.3352	311.0987	138.8225	0.0000	0.0000	0.0000	0.0000	310.1121	612.0212	900.9961	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9073	89.8428	89.7116	89.4104	88.8107	87.3000	87.3000	87.3000	87.3000	89.3811	89.7726	89.9314	(217)
Fuel for water heating, kWh/month	194.7208	170.8645	177.6167	156.8368	152.5982	135.5997	127.2799	143.7432	144.7757	162.8382	175.0778	189.0089	(219)
Water heating fuel used												1930.9604	(219)
Annual totals kWh/year													
Space heating fuel - main system												4393.9228	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5578.2896	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4393.9228	3.4800	152.9085	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1930.9604	3.4800	67.1974	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			241.6302	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7129 (257)
SAP value		90.0554
SAP rating (Section 12)		90 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4393.9228	0.2160	949.0873	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1930.9604	0.2160	417.0874	(264)
Space and water heating			1366.1748	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			978.6927	(272)
CO2 emissions per m2			10.0500	(273)
EI value			90.7878	
EI rating			91	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4511	0.4189	0.4296	0.4081	0.4081	0.3974	0.3866	0.3759	0.3652	0.3974	0.3759	0.3974	(22b)
Effective ac	0.6017	0.5877	0.5923	0.5833	0.5833	0.5790	0.5747	0.5706	0.5667	0.5790	0.5706	0.5790	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8696	48.7082	49.0857	48.3401	48.3401	47.9817	47.6327	47.2934	46.9636	47.9817	47.2934	47.9817	(38)
Heat transfer coeff	134.5964	133.4350	133.8126	133.0669	133.0669	132.7085	132.3596	132.0202	131.6904	132.7085	132.0202	132.7085	(39)
Average = Sum(39)m / 12 =												132.8495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3825	1.3705	1.3744	1.3668	1.3668	1.3631	1.3595	1.3560	1.3526	1.3631	1.3560	1.3631	(40)
HLP (average)												1.3645	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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Daily hot water use
            108.5156  104.5695  100.6235   96.6775   92.7315   88.7855   88.7855   92.7315   96.6775  100.6235  104.5695  108.5156 (44)
Energy conte  160.9254  140.7464  145.2377  126.6217  121.4966  104.8423   97.1518  111.4831  112.8146  131.4745  143.5147  155.8477 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
             24.1388   21.1120   21.7857   18.9933   18.2245   15.7263   14.5728   16.7225   16.9222   19.7212   21.5272   23.3772 (46)
Water storage loss:
Total storage loss
              0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss    14.1428   12.7631   14.1051   13.6066   14.0270   13.5362   13.9636   14.0047   13.5746   14.0721   13.6572   14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
             57.0434   49.9890   51.8178   45.5034   43.9044   38.2441   35.7939   40.5693   40.9045   47.2333   51.1330   55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
               Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m       162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943   49.9113   40.5906   30.7297   22.9708   19.3929   20.9547   27.2377   36.5584   46.4193   54.1782   57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012  380.0040  370.1692  349.2320  322.8026  297.9627  281.3681  277.4654  287.3002  308.2373  334.6667  359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959 (69)
Pumps, fans    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 (71)
Water heating gains (Table 5)
              76.6712   74.3883   69.6476   63.1991   59.0112   53.1168   48.1100   54.5286   56.8118   63.4856   71.0180   74.3979 (72)
Total internal gains
             620.2368  615.5736  591.6774  554.4309  516.0547  481.7425  461.7029  470.5018  491.9405  529.4124  571.1330  602.9307 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	13.4839	0.4600	0.0000	0.7700	29.9932	(74)
East	7.7400	25.1925	0.4600	0.0000	0.7700	69.0656	(76)
South	2.6200	56.7559	0.4600	0.0000	0.7700	52.6697	(78)
West	1.3100	25.1925	0.4600	0.0000	0.7700	11.6894	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

```
Solar gains  230.3606  349.8676  520.9835  707.2576  797.9519  880.4696  834.0926  749.0166  616.9653  428.7075  278.5314  191.4913 (83)
Total gains  850.5974  965.4412 1112.6609 1261.6885 1314.0066 1362.2121 1295.7956 1219.5184 1108.9058  958.1199  849.6644  794.4220 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
               Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau         36.0364   36.3500   36.2475   36.4506   36.4506   36.5490   36.6454   36.7396   36.8316   36.5490   36.7396   36.5490
alpha        3.4024    3.4233    3.4165    3.4300    3.4300    3.4366    3.4430    3.4493    3.4554    3.4366    3.4493    3.4366
util living area
              0.9744    0.9607    0.9239    0.8425    0.7131    0.5200    0.3881    0.4095    0.6529    0.8702    0.9542    0.9784 (86)

MIT          19.4237   19.6212   20.0024   20.4476   20.7706   20.9431   20.9843   20.9816   20.8747   20.4792   19.9115   19.4076 (87)
Th 2         19.7768   19.7860   19.7830   19.7889   19.7889   19.7918   19.7945   19.7972   19.7999   19.7918   19.7972   19.7918 (88)
util rest of house
              0.9680    0.9513    0.9054    0.8048    0.6459    0.4228    0.2729    0.2890    0.5584    0.8290    0.9410    0.9729 (89)
MIT 2        17.7428   18.0310   18.5678   19.1765   19.5790   19.7569   19.7892   19.7909   19.7088   19.2383   18.4590   17.7297 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.2028 (91)
MIT          18.0836   18.3534   18.8587   19.4343   19.8206   19.9974   20.0315   20.0323   19.9452   19.4899   18.7535   18.0699 (92)
Temperature adjustment                                                                                                    -0.1500
adjusted MIT 17.9336   18.2034   18.7087   19.2843   19.6706   19.8474   19.8815   19.8823   19.7952   19.3399   18.6035   17.9199 (93)
```

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8. Space heating requirement

```
               Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9542    0.9343    0.8845    0.7863    0.6386    0.4276    0.2814    0.2978    0.5579    0.8099    0.9230    0.9605 (94)
Useful gains 811.6639  902.0060  984.1627  992.0330  839.1052  582.4322  364.6880  363.2150  618.7126  775.9987  784.2627  763.0812 (95)
Ext temp.     4.9000    5.3000    7.0000    9.5000   12.5000   15.3000   17.1000   17.1000   14.7000   11.4000    7.9000    5.0000 (96)
Heat loss rate W
            1754.2787 1721.7671 1566.7697 1301.9607  954.1760  603.4836  368.1626  367.3259  670.9848 1053.6945 1413.0775 1714.5805 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             701.3054  550.8795  433.4596  223.1480   85.6127    0.0000    0.0000    0.0000    0.0000  206.6056  452.7466  707.9155 (98)
Space heating                                                                                                            3361.6729 (98)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 34.5283 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3714.5557	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	701.3054	550.8795	433.4596	223.1480	85.6127	0.0000	0.0000	0.0000	0.0000	206.6056	452.7466	707.9155	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	774.9231	608.7066	478.9609	246.5723	94.5997	0.0000	0.0000	0.0000	0.0000	228.2935	500.2725	782.2270	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8421	89.7828	89.6170	89.2377	88.5117	87.3000	87.3000	87.3000	87.3000	89.1494	89.6532	89.8622	(217)
Fuel for water heating, kWh/month													
	194.8620	170.9788	177.8042	157.1402	153.1138	135.5997	127.2799	143.7432	144.7757	163.2615	175.3111	189.1543	(219)
Water heating fuel used												1933.0244	(219)
Annual totals kWh/year													
Space heating fuel - main system												3714.5557	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4750.5665	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3714.5557	9.7400	361.7977	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1933.0244	9.7400	188.2766	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	396.9635	36.8500	146.2811	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			323.5248	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3714.5557	0.2160	802.3440	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.0244	0.2160	417.5333	(264)
Space and water heating			1219.8773	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			754.3272	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3714.5557	1.2200	4531.7579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.0244	1.2200	2358.2897	(264)
Space and water heating			6890.0476	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			4136.2159 (272)
Primary energy kWh/m2/year			42.4837 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 91

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 80	-192 kg (25.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£80	1.97 kg/m²	B 91	A 93
Total Savings	£80	1.97 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£174	£192	-£18
Mains gas	£654	£556	£98
Space heating	£493	£493	£0
Water heating	£188	£108	£80
Lighting	£146	£146	£0
Generated (PV)	-£504	-£504	£0
Total cost of fuels	£324	£244	£80
Total cost of uses	£323	£243	£80
Delivered energy	49 kWh/m²	39 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	31 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5477	0.5370	0.5262	0.4725	0.4618	0.4081	0.4081	0.3974	0.4296	0.4618	0.4833	0.5048	(22b)
Effective ac	0.6500	0.6442	0.6385	0.6117	0.6066	0.5833	0.5833	0.5790	0.5923	0.6066	0.6168	0.6274	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.8701	53.3874	52.9142	50.6917	50.2759	48.3401	48.3401	47.9817	49.0857	50.2759	51.1171	51.9965	(38)
Heat transfer coeff	138.5970	138.1142	137.6410	135.4185	135.0027	133.0669	133.0669	132.7085	133.8126	135.0027	135.8439	136.7233	(39)
Average = Sum(39)m / 12 =												135.4165	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4236	1.4186	1.4137	1.3909	1.3866	1.3668	1.3668	1.3631	1.3744	1.3866	1.3953	1.4043	(40)
HLP (average)												1.3909	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
            108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
             24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.1684 (H8)
Utilisation factor                                                                                                                    0.5751 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -866.7922 (H17)
Solar input    -25.1352   -41.9435   -71.4346   -95.7364  -118.2743  -116.2825  -114.7457  -100.2539   -78.5189   -53.6192   -29.8140   -21.0339 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =  -866.7922 (63)
Output from w/h
            149.9330   111.5660    87.9082    44.4919    17.2493     2.0961     0.0000    25.2339    47.8702    91.9274   127.3579   148.9444 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    854.5783 (64)
Heat gains from water heating, kWh/month
             57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
              Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
              76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
             620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

```
[Jan]                                      Area          Solar flux              g                FF            Access            Gains
                                           m2            Table 6a      Specific data      Specific data      factor                W
                                                           W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
North                                    6.2800           10.6334            0.4600             0.0000        0.7700           23.6527 (74)
East                                     7.7400           19.6403            0.4600             0.0000        0.7700           53.8439 (76)
South                                    2.6200           46.7521            0.4600             0.0000        0.7700           43.3861 (78)
West                                     1.3100           19.6403            0.4600             0.0000        0.7700            9.1131 (80)
South                                    3.3300           46.7521            0.4600             0.0000        0.7700           55.1434 (78)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains    805.3760   945.2984  1076.8599  1205.9274  1286.8600  1263.7420  1208.7515  1126.8365  1034.9030   903.4037   795.6027   759.5601 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
              Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau        34.9962    35.1185    35.2392    35.8176    35.9279    36.4506    36.4506    36.5490    36.2475    35.9279    35.7054    35.4758
alpha       3.3331     3.3412     3.3493     3.3878     3.3952     3.4300     3.4300     3.4366     3.4165     3.3952     3.3804     3.3651
util living area
              0.9805     0.9662     0.9374     0.8736     0.7629     0.6052     0.4627     0.5094     0.7276     0.9068     0.9681     0.9837 (86)

MIT           19.2200    19.4689    19.8462    20.3122    20.6778    20.8974    20.9691    20.9569    20.7990    20.3118    19.6868    19.1833 (87)
Th 2          19.7453    19.7491    19.7528    19.7703    19.7736    19.7889    19.7889    19.7918    19.7830    19.7736    19.7670    19.7600 (88)
util rest of house
              0.9757     0.9580     0.9220     0.8422     0.7046     0.5129     0.3447     0.3890     0.6434     0.8764     0.9590     0.9797 (89)
MIT 2         17.4290    17.7890    18.3286    18.9845    19.4578    19.7157    19.7756    19.7714    19.6194    19.0036    18.1193    17.3851 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2028 (91)
MIT           17.7921    18.1296    18.6363    19.2537    19.7052    19.9553    20.0176    20.0118    19.8586    19.2689    18.4371    17.7497 (92)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.6421	17.9796	18.4863	19.1037	19.5552	19.8053	19.8676	19.8618	19.7086	19.1189	18.2871	17.5997	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9637	0.9417	0.9014	0.8215	0.6929	0.5142	0.3527	0.3964	0.6375	0.8555	0.9432	0.9691	(94)
Useful gains	776.1025	890.2196	970.6514	990.7293	891.6080	649.8741	426.3710	446.7066	659.7381	772.8483	750.4245	736.0793	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1849.1778	1806.4814	1649.8091	1381.7632	1060.4714	692.6493	434.8105	459.4068	750.5004	1150.0681	1519.7011	1832.0490	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	798.3680	615.7279	505.2934	281.5444	125.6344	0.0000	0.0000	0.0000	0.0000	280.6515	553.8792	815.4015	(98)
Space heating												3976.5001	(98)
Space heating per m2											(98) / (4) =	40.8433	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4393.9228	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	798.3680	615.7279	505.2934	281.5444	125.6344	0.0000	0.0000	0.0000	0.0000	280.6515	553.8792	815.4015	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	882.1746	680.3623	558.3352	311.0987	138.8225	0.0000	0.0000	0.0000	0.0000	310.1121	612.0212	900.9961	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9785	89.9940	90.0111	90.0496	90.1013	87.3000	87.3000	87.3000	87.3000	89.6889	89.8840	89.9905	(217)
Fuel for water heating, kWh/month	166.6319	123.9705	97.6638	49.4083	19.1443	2.4010	0.0000	28.9048	54.8342	102.4959	141.6914	165.5112	(219)
Water heating fuel used												952.6572	(219)
Annual totals kWh/year													
Space heating fuel - main system												4393.9228	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4649.9865	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4393.9228	3.4800	152.9085	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.6572	3.4800	33.1525	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			214.1803	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6319	(257)
SAP value	91.1851	
SAP rating (Section 12)	91	(258)
SAP band	B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4393.9228	0.2160	949.0873	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.6572	0.2160	205.7740	(264)
Space and water heating			1154.8613	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			793.3292	(272)
CO2 emissions per m2			8.1500	(273)
EI value			92.5326	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.6100	
Infiltration rate		0.4296	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4296	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4511	0.4189	0.4296	0.4081	0.4081	0.3974	0.3866	0.3759	0.3652	0.3974	0.3759	0.3974	(22b)
Effective ac	0.6017	0.5877	0.5923	0.5833	0.5833	0.5790	0.5747	0.5706	0.5667	0.5790	0.5706	0.5790	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8696	48.7082	49.0857	48.3401	48.3401	47.9817	47.6327	47.2934	46.9636	47.9817	47.2934	47.9817	(38)
Heat transfer coeff	134.5964	133.4350	133.8126	133.0669	133.0669	132.7085	132.3596	132.0202	131.6904	132.7085	132.0202	132.7085	(39)
Average = Sum(39)m / 12 =												132.8495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3825	1.3705	1.3744	1.3668	1.3668	1.3631	1.3595	1.3560	1.3526	1.3631	1.3560	1.3631	(40)
HLP (average)												1.3645	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
            108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
             24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1208.1510 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             2029.6937 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.3077 (H8)
Utilisation factor                                                                                                                    0.5345 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -901.6911 (H17)
Solar input    -29.4153   -41.8267   -71.8901   -96.9964  -113.9281  -121.6932  -119.1340  -106.6286   -83.4828   -57.7171   -34.7906   -24.1880 (63)
                                                                                        Solar input (sum of months) = Sum(63)m =   -901.6911 (63)
Output from w/h
            145.6529   111.6827    87.4527    43.2319    21.5954     0.0000     0.0000    18.8592    42.9063    87.8295   122.3814   145.7903 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =    827.3824 (64)
Heat gains from water heating, kWh/month
             57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
              76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
             620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

```
[Jan]                                        Area          Solar flux              g                FF            Access            Gains
                                             m2           Table 6a      Specific data     Specific data        factor                W
                                                            W/m2        or Table 6b       or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
North                                      6.2800           13.4839            0.4600            0.0000            0.7700           29.9932 (74)
East                                       7.7400           25.1925            0.4600            0.0000            0.7700           69.0656 (76)
South                                      2.6200           56.7559            0.4600            0.0000            0.7700           52.6697 (78)
West                                       1.3100           25.1925            0.4600            0.0000            0.7700           11.6894 (80)
South                                      3.3300           56.7559            0.4600            0.0000            0.7700           66.9427 (78)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    230.3606   349.8676   520.9835   707.2576   797.9519   880.4696   834.0926   749.0166   616.9653   428.7075   278.5314   191.4913 (83)
Total gains    850.5974   965.4412  1112.6609  1261.6885  1314.0066  1362.2121  1295.7956  1219.5184  1108.9058   958.1199   849.6644   794.4220 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          36.0364    36.3500    36.2475    36.4506    36.4506    36.5490    36.6454    36.7396    36.8316    36.5490    36.7396    36.5490
alpha         3.4024     3.4233     3.4165     3.4300     3.4300     3.4366     3.4430     3.4493     3.4554     3.4366     3.4493     3.4366
util living area
              0.9744     0.9607     0.9239     0.8425     0.7131     0.5200     0.3881     0.4095     0.6529     0.8702     0.9542     0.9784 (86)

MIT           19.4237    19.6212    20.0024    20.4476    20.7706    20.9431    20.9843    20.9816    20.8747    20.4792    19.9115    19.4076 (87)
Th 2          19.7768    19.7860    19.7830    19.7889    19.7889    19.7918    19.7945    19.7972    19.7999    19.7918    19.7972    19.7918 (88)
util rest of house
              0.9680     0.9513     0.9054     0.8048     0.6459     0.4228     0.2729     0.2890     0.5584     0.8290     0.9410     0.9729 (89)
MIT 2         17.7428    18.0310    18.5678    19.1765    19.5790    19.7569    19.7892    19.7909    19.7088    19.2383    18.4590    17.7297 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2028 (91)
MIT           18.0836    18.3534    18.8587    19.4343    19.8206    19.9974    20.0315    20.0323    19.9452    19.4899    18.7535    18.0699 (92)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.9336	18.2034	18.7087	19.2843	19.6706	19.8474	19.8815	19.8823	19.7952	19.3399	18.6035	17.9199	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9542	0.9343	0.8845	0.7863	0.6386	0.4276	0.2814	0.2978	0.5579	0.8099	0.9230	0.9605	(94)
Useful gains	811.6639	902.0060	984.1627	992.0330	839.1052	582.4322	364.6880	363.2150	618.7126	775.9987	784.2627	763.0812	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1754.2787	1721.7671	1566.7697	1301.9607	954.1760	603.4836	368.1626	367.3259	670.9848	1053.6945	1413.0775	1714.5805	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	701.3054	550.8795	433.4596	223.1480	85.6127	0.0000	0.0000	0.0000	0.0000	206.6056	452.7466	707.9155	(98)
Space heating												3361.6729	(98)
Space heating per m2											(98) / (4) =	34.5283	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3714.5557	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	701.3054	550.8795	433.4596	223.1480	85.6127	0.0000	0.0000	0.0000	0.0000	206.6056	452.7466	707.9155	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	774.9231	608.7066	478.9609	246.5723	94.5997	0.0000	0.0000	0.0000	0.0000	228.2935	500.2725	782.2270	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9331	89.9443	89.9465	89.9648	89.8367	87.3000	87.3000	87.3000	87.3000	89.5212	89.7996	89.9370	(217)
Fuel for water heating, kWh/month	161.9569	124.1688	97.2275	48.0542	24.0385	0.0000	0.0000	21.6028	49.1482	98.1103	136.2828	162.1027	(219)
Water heating fuel used												922.6927	(219)
Annual totals kWh/year													
Space heating fuel - main system												3714.5557	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3790.2348	(238)

10a. Fuel costs - using BEDF prices (514)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3714.5557	9.7400	361.7977	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	922.6927	9.7400	89.8703	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	396.9635	36.8500	146.2811	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.8500	-504.4681	(252)
Total energy cost			243.5435	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3714.5557	0.2160	802.3440	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.6927	0.2160	199.3016	(264)
Space and water heating			1001.6457	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			562.0456 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3714.5557	1.2200	4531.7579 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	922.6927	1.2200	1125.6851 (264)
Space and water heating			5657.4430 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	396.9635	3.0700	1218.6781 (268)
Energy saving/generation technologies			
PV Unit	-1368.9771	3.0700	-4202.7598 (269)
Primary energy kWh/year			3057.1113 (272)
Primary energy kWh/m2/year			31.4001 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	331.51 (P1)
Transmission heat loss coefficient	84.73 (37)
Summer heat loss coefficient	416.23 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.2800	81.1852	0.4600	0.0000	0.9000	211.0750
East	7.7400	117.5071	0.4600	0.0000	0.9000	376.5349
South	2.6200	112.2060	0.4600	0.0000	0.9000	121.7076
West	1.3100	117.5071	0.4600	0.0000	0.9000	63.7288
South	3.3300	112.2060	0.4600	0.0000	0.9000	154.6894
total:						927.7357

	Jun	Jul	Aug	
Solar gains	982	928	832	(P4)
Internal gains	479	459	468	
Total summer gains	1461	1386	1299	(P5)
Summer gain/loss ratio	3.51	3.33	3.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	20.25	21.98	21.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-354	**Issued on Date**	15/03/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	2, Chaffinch Gardens, BOTLEY, SO32 2US		

SAP Rating	91 B	**DER**	10.64	**TER**	18.49
Environmental	92 A	**% DER<TER**	42.46		
CO_2 Emissions (t/year)	0.66	**DFEE**	50.26	**TFEE**	56.71
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.37		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS BUILT

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.49 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.64 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.93 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 5.06 m², No overhang
Windows facing East: 0.72 m², No overhang
Windows facing South: 7.64 m², No overhang
Windows facing West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9300	
Infiltration rate			0.4082	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5204	0.5102	0.5000	0.4490	0.4388	0.3878	0.3878	0.3776	0.4082	0.4388	0.4592	0.4796	(22b)
Effective ac	0.6354	0.6302	0.6250	0.6008	0.5963	0.5752	0.5752	0.5713	0.5833	0.5963	0.6054	0.6150	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8790	51.4497	51.0289	49.0522	48.6824	46.9608	46.9608	46.6420	47.6240	48.6824	49.4306	50.2127	(38)
Heat transfer coeff	125.6637	125.2344	124.8135	122.8369	122.4671	120.7455	120.7455	120.4267	121.4086	122.4671	123.2152	123.9974	(39)
Average = Sum(39)m / 12 =												122.8351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3130	1.3085	1.3041	1.2834	1.2796	1.2616	1.2616	1.2582	1.2685	1.2796	1.2874	1.2956	(40)
HLP (average)												1.2834	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
								Total per year (kWh/year) = Sum(64)m =				1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	571.1581	676.4620	756.1957	818.4503	851.1811	826.4642	791.9292	754.3507	716.3746	643.4640	567.6036	536.4095	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6973	35.8197	35.9404	36.5188	36.6291	37.1513	37.1513	37.2497	36.9484	36.6291	36.4067	36.1770	
alpha	3.3798	3.3880	3.3960	3.4346	3.4419	3.4768	3.4768	3.4833	3.4632	3.4419	3.4271	3.4118	
util living area													
	0.9910	0.9834	0.9693	0.9377	0.8722	0.7499	0.6047	0.6456	0.8324	0.9504	0.9847	0.9927	(86)
MIT	19.0538	19.2825	19.6296	20.0807	20.4925	20.8033	20.9326	20.9138	20.6902	20.1525	19.5259	19.0227	(87)
Th 2	19.8307	19.8342	19.8376	19.8538	19.8569	19.8711	19.8711	19.8737	19.8656	19.8569	19.8507	19.8443	(88)
util rest of house													
	0.9888	0.9794	0.9614	0.9202	0.8325	0.6666	0.4754	0.5204	0.7669	0.9330	0.9803	0.9910	(89)
MIT 2	17.2511	17.5854	18.0898	18.7442	19.3125	19.7099	19.8363	19.8252	19.5825	18.8571	17.9520	17.2141	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.5254	17.8436	18.3241	18.9475	19.4920	19.8763	20.0031	19.9908	19.7510	19.0542	18.1914	17.4893	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3754	17.6936	18.1741	18.7975	19.3420	19.7263	19.8531	19.8408	19.6010	18.9042	18.0414	17.3393	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9682	0.9451	0.8985	0.8101	0.6541	0.4732	0.5163	0.7480	0.9126	0.9695	0.9847	(94)
Useful gains	560.5776	654.9194	714.6578	735.3761	689.5621	540.6183	374.7209	389.4999	535.8498	587.1992	550.2776	528.2219	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1643.0997	1602.1990	1457.0807	1215.7806	935.8924	618.9730	392.7967	414.3659	667.8675	1016.9858	1348.1521	1629.2325	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	805.3964	636.5719	552.3627	345.8913	183.2698	0.0000	0.0000	0.0000	0.0000	319.7613	574.4696	819.1519	(98)
Space heating												4236.8748	(98)
Space heating per m2											(98) / (4) =	44.2678	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4681.6296	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	805.3964	636.5719	552.3627	345.8913	183.2698	0.0000	0.0000	0.0000	0.0000	319.7613	574.4696	819.1519	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	889.9408	703.3944	610.3455	382.2003	202.5080	0.0000	0.0000	0.0000	0.0000	353.3274	634.7730	905.1402	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9134	89.8620	89.7655	89.5557	89.1144	87.3000	87.3000	87.3000	87.3000	89.4768	89.7951	89.9353	(217)
Fuel for water heating, kWh/month													
	193.9474	170.1627	176.8228	155.9805	151.4979	135.0886	126.8064	143.1997	144.2255	162.0400	174.3552	188.2646	(219)
Water heating fuel used												1922.3912	(219)
Annual totals kWh/year													
Space heating fuel - main system												4681.6296	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =											-1278.1572	-1278.1572	(233)
Total delivered energy for all uses												5816.9430	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4681.6296	0.2160	1011.2320	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.3912	0.2160	415.2365	(264)
Space and water heating			1426.4685	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1017.9751	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.6400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.6400	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		27.9884	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.9884	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.6300	0.7000	0.7700	16.4435	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	7.6400	46.7521	0.6300	0.7000	0.7700	109.1606	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	134.2475	227.1095	308.9732	383.7657	433.5212	432.7543	416.1804	378.2003	334.4777	250.2973	160.4550	115.1408	(83)
Total gains	562.1867	652.7313	719.4586	769.1990	793.3578	768.1032	736.2111	705.3298	674.9703	616.0665	554.4758	530.4798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9982	0.9959	0.9904	0.9741	0.9266	0.8067	0.6422	0.6863	0.8870	0.9802	0.9962	0.9986	(86)
MIT	19.6433	19.8023	20.0486	20.3731	20.6755	20.8958	20.9740	20.9640	20.8166	20.4250	19.9766	19.6204	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9975	0.9945	0.9869	0.9633	0.8928	0.7191	0.5039	0.5516	0.8236	0.9698	0.9946	0.9981	(89)
MIT 2	18.0934	18.3274	18.6879	19.1644	19.5827	19.8559	19.9210	19.9176	19.7716	19.2449	18.5924	18.0678	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.3291	18.5518	18.8949	19.3483	19.7490	20.0141	20.0812	20.0768	19.9306	19.4244	18.8030	18.3040	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3291	18.5518	18.8949	19.3483	19.7490	20.0141	20.0812	20.0768	19.9306	19.4244	18.8030	18.3040	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9918	0.9821	0.9556	0.8861	0.7269	0.5247	0.5713	0.8239	0.9631	0.9920	0.9970	(94)
Useful gains	559.9961	647.3865	706.5718	735.0242	703.0271	558.3259	386.2677	402.9841	556.0768	593.3440	550.0583	528.9040	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1649.5255	1600.3084	1448.6587	1204.0605	925.0982	614.5485	395.1516	416.3835	665.0257	1014.2237	1352.3154	1638.8855	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	810.6098	640.3635	552.1127	337.7061	165.2209	0.0000	0.0000	0.0000	0.0000	313.1344	577.6251	825.8263	(98)
Space heating												4222.5988	(98)
Space heating per m2											(98) / (4) =	44.1187	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4520.9838	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	810.6098	640.3635	552.1127	337.7061	165.2209	0.0000	0.0000	0.0000	0.0000	313.1344	577.6251	825.8263	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	867.8906	685.6140	591.1271	361.5697	176.8961	0.0000	0.0000	0.0000	0.0000	335.2617	618.4423	884.1823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1094	87.9094	87.5205	86.6982	85.0087	80.3000	80.3000	80.3000	80.3000	86.4069	87.6474	88.1843	(217)
Fuel for water heating, kWh/month													
	239.7049	211.7833	223.4690	200.1885	197.6697	184.3053	176.5785	196.8436	199.0176	210.4883	219.3125	233.7674	(219)
Water heating fuel used												2493.1286	(219)
Annual totals kWh/year													
Space heating fuel - main system												4520.9838	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7505.1918	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4520.9838	0.2160	976.5325	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2493.1286	0.2160	538.5158	(264)
Space and water heating			1515.0483	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1769.9185	(272)
Emissions per m2 for space and water heating			15.8296	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8296 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.4900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			4.9300	
Infiltration rate			0.3678	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3678	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4689	0.4597	0.4505	0.4045	0.3953	0.3494	0.3494	0.3402	0.3678	0.3953	0.4137	0.4321	(22b)
Effective ac	0.6099	0.6057	0.6015	0.5818	0.5781	0.5610	0.5610	0.5579	0.5676	0.5781	0.5856	0.5934	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.7978	49.4493	49.1076	47.5031	47.2029	45.8054	45.8054	45.5466	46.3437	47.2029	47.8102	48.4451	(38)
Heat transfer coeff	123.5824	123.2339	122.8923	121.2877	120.9875	119.5900	119.5900	119.3312	120.1283	120.9875	121.5948	122.2298	(39)
Average = Sum(39)m / 12 =												121.2863	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2912	1.2876	1.2840	1.2672	1.2641	1.2495	1.2495	1.2468	1.2551	1.2641	1.2705	1.2771	(40)
HLP (average)												1.2672	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	537.5606	643.6876	725.1304	789.7124	823.9553	801.3652	768.6345	728.7406	689.9392	614.6203	536.0442	503.6316	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2985	36.4011	36.5023	36.9852	37.0770	37.5103	37.5103	37.5916	37.3422	37.0770	36.8918	36.7002	
alpha	3.4199	3.4267	3.4335	3.4657	3.4718	3.5007	3.5007	3.5061	3.4895	3.4718	3.4595	3.4467	
util living area													
	0.9926	0.9856	0.9724	0.9425	0.8793	0.7596	0.6146	0.6578	0.8425	0.9557	0.9871	0.9940	(86)
MIT	19.0467	19.2758	19.6231	20.0714	20.4852	20.7980	20.9306	20.9103	20.6812	20.1381	19.5106	19.0112	(87)
Th 2	19.8477	19.8506	19.8534	19.8666	19.8691	19.8806	19.8806	19.8827	19.8762	19.8691	19.8641	19.8588	(88)
util rest of house													
	0.9907	0.9821	0.9653	0.9261	0.8411	0.6777	0.4855	0.5331	0.7795	0.9399	0.9833	0.9926	(89)
MIT 2	18.0749	18.3044	18.6501	19.0979	19.4897	19.7666	19.8559	19.8478	19.6752	19.1705	18.5493	18.0477	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.2227	18.4522	18.7981	19.2460	19.6411	19.9235	20.0194	20.0094	19.8282	19.3177	18.6955	18.1943	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2227	18.4522	18.7981	19.2460	19.6411	19.9235	20.0194	20.0094	19.8282	19.3177	18.6955	18.1943	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9762	0.9565	0.9148	0.8319	0.6813	0.5030	0.5489	0.7762	0.9297	0.9779	0.9895	(94)
Useful gains	530.6044	628.3842	693.6120	722.3935	685.4316	545.9823	386.6111	399.9721	535.5524	571.4257	524.1775	498.3556	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1720.6055	1670.0885	1511.3423	1254.8450	960.7770	636.6424	408.9239	430.7178	688.1226	1054.7306	1409.9559	1710.5218	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	885.3609	700.0253	608.3913	383.3651	204.8569	0.0000	0.0000	0.0000	0.0000	359.5788	637.7605	901.8517	(98)
Space heating												4681.1905	(98)
Space heating per m2											(98) / (4) =	48.9102	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1124.1462	884.9661	906.9173	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7466	0.8225	0.7976	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	839.2451	727.9129	723.3949	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.8324	999.4253	954.7774	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	144.4228	202.0052	172.1486	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												518.5766	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	36.1057	50.5013	43.0371	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												129.6442	(107)
Space cooling per m2												1.3546	(108)
Energy for space heating												48.9102	(99)
Energy for space cooling												1.3546	(108)
Total												50.2647	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.6300	0.7000	0.7700	16.4435	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	7.6400	46.7521	0.6300	0.7000	0.7700	109.1606	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	134.2475	227.1095	308.9732	383.7657	433.5212	432.7543	416.1804	378.2003	334.4777	250.2973	160.4550	115.1408	(83)
Total gains	516.2177	607.5812	676.0092	728.7006	755.0332	732.5650	702.4693	668.6135	636.7633	574.8275	510.5348	485.3263	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9987	0.9970	0.9926	0.9789	0.9375	0.8271	0.6665	0.7137	0.9048	0.9849	0.9973	0.9991	(86)
MIT	19.5992	19.7594	20.0084	20.3382	20.6490	20.8825	20.9695	20.9573	20.7947	20.3883	19.9347	19.5768	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9983	0.9959	0.9898	0.9699	0.9074	0.7428	0.5260	0.5782	0.8473	0.9768	0.9962	0.9988	(89)
MIT 2	18.6217	18.7838	19.0338	19.3699	19.6670	19.8718	19.9229	19.9202	19.8049	19.4239	18.9701	18.6084	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.7704	18.9322	19.1821	19.5172	19.8164	20.0255	20.0821	20.0780	19.9554	19.5706	19.1168	18.7557	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7704	18.9322	19.1821	19.5172	19.8164	20.0255	20.0821	20.0780	19.9554	19.5706	19.1168	18.7557	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9946	0.9872	0.9655	0.9039	0.7515	0.5475	0.5985	0.8492	0.9732	0.9950	0.9982	(94)
Useful gains	514.9980	604.2909	667.3695	703.5544	682.4457	550.4975	384.5888	400.1671	540.7616	559.4134	507.9681	484.4758	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1701.4034	1644.8993	1482.2188	1223.5250	932.8476	615.8521	395.2497	416.5182	667.8617	1031.0236	1388.5797	1691.3759	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	882.6856	699.2889	606.2479	374.3789	186.2990	0.0000	0.0000	0.0000	0.0000	350.8780	634.0404	897.9337	(98)
Space heating												4631.7524	(98)
Space heating per m2											(98) / (4) =	48.3936	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8669	0.8420	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	836.1540	728.1543	724.6957	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	959.4166	922.0893	884.4990	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	88.7490	144.2876	118.8936	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												351.9302 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	22.1873	36.0719	29.7234	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												87.9826 (107)
Space cooling per m2												0.9193 (108)
Energy for space heating												48.3936 (99)
Energy for space cooling												0.9193 (108)
Total												49.3129 (109)
Target Fabric Energy Efficiency (TFEE)												56.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9300	
Infiltration rate		0.4082	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4286	0.3980	0.4082	0.3878	0.3878	0.3776	0.3674	0.3572	0.3469	0.3776	0.3572	0.3776	(22b)
Effective ac	0.5918	0.5792	0.5833	0.5752	0.5752	0.5713	0.5675	0.5638	0.5602	0.5713	0.5638	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3211	47.2881	47.6240	46.9608	46.9608	46.6420	46.3317	46.0299	45.7366	46.6420	46.0299	46.6420	(38)
Heat transfer coeff	122.1057	121.0728	121.4086	120.7455	120.7455	120.4267	120.1164	119.8145	119.5212	120.4267	119.8145	120.4267	(39)
Average = Sum(39)m / 12 =												120.5521	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2758	1.2650	1.2685	1.2616	1.2616	1.2582	1.2550	1.2518	1.2488	1.2582	1.2518	1.2582	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (64)

Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)
RHI water heating demand 1711 (64)
Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)
Total internal gains												
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	13.4839	0.4600	0.0000	0.7700	24.1665	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	4.3100	56.7559	0.4600	0.0000	0.7700	86.6436	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	190.6023	274.4744	377.7227	475.9279	515.0217	560.4054	533.9226	493.9804	433.0960	326.6197	227.0461	160.7324	(83)
Total gains	808.6038	887.4767	966.5088	1027.2511	1027.9053	1039.1043	992.8621	962.0372	922.9217	854.1327	796.3290	761.6962	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7375	37.0509	36.9484	37.1513	37.1513	37.2497	37.3459	37.4400	37.5319	37.2497	37.4400	37.2497	
alpha	3.4492	3.4701	3.4632	3.4768	3.4768	3.4833	3.4897	3.4960	3.5021	3.4833	3.4960	3.4833	
util living area	0.9720	0.9608	0.9336	0.8768	0.7760	0.5979	0.4531	0.4649	0.6931	0.8775	0.9518	0.9758	(86)
MIT	19.4883	19.6537	19.9766	20.3728	20.7061	20.9162	20.9760	20.9742	20.8539	20.4769	19.9542	19.4773	(87)
Th 2	19.8598	19.8684	19.8656	19.8711	19.8711	19.8737	19.8762	19.8787	19.8812	19.8737	19.8787	19.8737	(88)
util rest of house	0.9656	0.9519	0.9181	0.8465	0.7177	0.5011	0.3309	0.3405	0.6055	0.8404	0.9389	0.9701	(89)
MIT 2	17.8972	18.1395	18.5974	19.1505	19.5844	19.8169	19.8669	19.8686	19.7671	19.3035	18.5812	17.8909	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1393	18.3698	18.8072	19.3365	19.7550	19.9842	20.0356	20.0368	19.9324	19.4820	18.7901	18.1323	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9893	18.2198	18.6572	19.1865	19.6050	19.8342	19.8856	19.8868	19.7824	19.3320	18.6401	17.9823	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9505	0.9342	0.8965	0.8241	0.7019	0.4974	0.3319	0.3414	0.5969	0.8182	0.9195	0.9564	(94)
Useful gains	768.5779	829.1230	866.4772	846.5539	721.5094	516.8565	329.5773	328.4585	550.8598	698.8925	732.2230	728.4640	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1598.2764	1564.2393	1415.2899	1169.5994	857.8997	546.0353	334.5998	333.8978	607.4598	955.2214	1286.8185	1563.4109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	617.2957	493.9981	408.3166	232.5928	101.4744	0.0000	0.0000	0.0000	0.0000	190.7087	399.3088	621.2005	(98)
Space heating												3064.8956	(98)
RHI space heating demand												3065	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9300	
Infiltration rate		0.4082	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5204	0.5102	0.5000	0.4490	0.4388	0.3878	0.3878	0.3776	0.4082	0.4388	0.4592	0.4796	(22b)
Effective ac	0.6354	0.6302	0.6250	0.6008	0.5963	0.5752	0.5752	0.5713	0.5833	0.5963	0.6054	0.6150	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8790	51.4497	51.0289	49.0522	48.6824	46.9608	46.9608	46.6420	47.6240	48.6824	49.4306	50.2127	(38)
Heat transfer coeff	125.6637	125.2344	124.8135	122.8369	122.4671	120.7455	120.7455	120.4267	121.4086	122.4671	123.2152	123.9974	(39)
Average = Sum(39)m / 12 =												122.8351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3130	1.3085	1.3041	1.2834	1.2796	1.2616	1.2616	1.2582	1.2685	1.2796	1.2874	1.2956	(40)
HLP (average)												1.2834	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	773.5919	876.2181	946.8805	996.1008	1015.3269	980.2535	941.2850	906.3842	877.4794	817.6031	755.2474	734.4099	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6973	35.8197	35.9404	36.5188	36.6291	37.1513	37.1513	37.2497	36.9484	36.6291	36.4067	36.1770	
alpha	3.3798	3.3880	3.3960	3.4346	3.4419	3.4768	3.4768	3.4833	3.4632	3.4419	3.4271	3.4118	
util living area													
	0.9781	0.9655	0.9439	0.8995	0.8172	0.6769	0.5279	0.5631	0.7576	0.9095	0.9653	0.9813	(86)
MIT	19.2958	19.5123	19.8343	20.2451	20.6041	20.8596	20.9559	20.9440	20.7781	20.3215	19.7432	19.2627	(87)
Th 2	19.8307	19.8342	19.8376	19.8538	19.8569	19.8711	19.8711	19.8737	19.8656	19.8569	19.8507	19.8443	(88)
util rest of house													
	0.9731	0.9578	0.9307	0.8745	0.7685	0.5900	0.4075	0.4442	0.6816	0.8818	0.9561	0.9771	(89)
MIT 2	17.6008	17.9144	18.3774	18.9651	19.4470	19.7616	19.8495	19.8440	19.6741	19.0832	18.2620	17.5615	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8587	18.1575	18.5991	19.1598	19.6230	19.9286	20.0178	20.0114	19.8420	19.2716	18.4874	17.8203	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7087	18.0075	18.4491	19.0098	19.4730	19.7786	19.8678	19.8614	19.6920	19.1216	18.3374	17.6703	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9406	0.9097	0.8513	0.7493	0.5820	0.4071	0.4428	0.6681	0.8587	0.9389	0.9651	(94)
Useful gains	742.4346	824.2084	861.3684	847.9524	760.7567	570.5477	383.1919	401.3198	586.2451	702.1070	709.0890	708.7894	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1684.9816	1641.5064	1491.4048	1241.8598	951.9388	625.2966	394.5769	416.8415	678.9174	1043.6113	1384.6144	1670.2846	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	701.2550	549.2243	468.7470	283.6134	142.2395	0.0000	0.0000	0.0000	0.0000	254.0793	486.3783	715.3524	(98)
Space heating												3600.8892	(98)
Space heating per m2											(98) / (4) =	37.6229	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3978.8830	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	701.2550	549.2243	468.7470	283.6134	142.2395	0.0000	0.0000	0.0000	0.0000	254.0793	486.3783	715.3524	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	774.8674	606.8777	517.9525	313.3849	157.1707	0.0000	0.0000	0.0000	0.0000	280.7506	537.4346	790.4447	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8441	89.7833	89.6686	89.4184	88.9130	87.3000	87.3000	87.3000	87.3000	89.3106	89.6994	89.8695	(217)
Fuel for water heating, kWh/month													
	194.0969	170.3120	177.0140	156.2199	151.8411	135.0886	126.8064	143.1997	144.2255	162.3415	174.5413	188.4024	(219)
Water heating fuel used												1924.0893	(219)
Annual totals kWh/year													
Space heating fuel - main system												3978.8830	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5115.8946	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3978.8830	3.4800	138.4651	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1924.0893	3.4800	66.9583	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			221.6079	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6615	(257)
SAP value		90.7725	
SAP rating (Section 12)		91	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3978.8830	0.2160	859.4387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1924.0893	0.2160	415.6033	(264)
Space and water heating			1275.0420	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			866.5487	(272)
CO2 emissions per m2			9.0500	(273)
EI value			91.7477	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9300	
Infiltration rate		0.4082	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4286	0.3980	0.4082	0.3878	0.3878	0.3776	0.3674	0.3572	0.3469	0.3776	0.3572	0.3776	(22b)
Effective ac	0.5918	0.5792	0.5833	0.5752	0.5752	0.5713	0.5675	0.5638	0.5602	0.5713	0.5638	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3211	47.2881	47.6240	46.9608	46.9608	46.6420	46.3317	46.0299	45.7366	46.6420	46.0299	46.6420	(38)
Heat transfer coeff	122.1057	121.0728	121.4086	120.7455	120.7455	120.4267	120.1164	119.8145	119.5212	120.4267	119.8145	120.4267	(39)
Average = Sum(39)m / 12 =												120.5521	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2758	1.2650	1.2685	1.2616	1.2616	1.2582	1.2550	1.2518	1.2488	1.2582	1.2518	1.2582	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	13.4839	0.4600	0.0000	0.7700	24.1665	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	4.3100	56.7559	0.4600	0.0000	0.7700	86.6436	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	190.6023	274.4744	377.7227	475.9279	515.0217	560.4054	533.9226	493.9804	433.0960	326.6197	227.0461	160.7324	(83)
Total gains	808.6038	887.4767	966.5088	1027.2511	1027.9053	1039.1043	992.8621	962.0372	922.9217	854.1327	796.3290	761.6962	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7375	37.0509	36.9484	37.1513	37.1513	37.2497	37.3459	37.4400	37.5319	37.2497	37.4400	37.2497	
alpha	3.4492	3.4701	3.4632	3.4768	3.4768	3.4833	3.4897	3.4960	3.5021	3.4833	3.4960	3.4833	
util living area													
	0.9720	0.9608	0.9336	0.8768	0.7760	0.5979	0.4531	0.4649	0.6931	0.8775	0.9518	0.9758	(86)
MIT	19.4883	19.6537	19.9766	20.3728	20.7061	20.9162	20.9760	20.9742	20.8539	20.4769	19.9542	19.4773	(87)
Th 2	19.8598	19.8684	19.8656	19.8711	19.8711	19.8737	19.8762	19.8787	19.8812	19.8737	19.8787	19.8737	(88)
util rest of house													
	0.9656	0.9519	0.9181	0.8465	0.7177	0.5011	0.3309	0.3405	0.6055	0.8404	0.9389	0.9701	(89)
MIT 2	17.8972	18.1395	18.5974	19.1505	19.5844	19.8169	19.8669	19.8686	19.7671	19.3035	18.5812	17.8909	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1393	18.3698	18.8072	19.3365	19.7550	19.9842	20.0356	20.0368	19.9324	19.4820	18.7901	18.1323	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9893	18.2198	18.6572	19.1865	19.6050	19.8342	19.8856	19.8868	19.7824	19.3320	18.6401	17.9823	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9505	0.9342	0.8965	0.8241	0.7019	0.4974	0.3319	0.3414	0.5969	0.8182	0.9195	0.9564	(94)
Useful gains	768.5779	829.1230	866.4772	846.5539	721.5094	516.8565	329.5773	328.4585	550.8598	698.8925	732.2230	728.4640	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1598.2764	1564.2393	1415.2899	1169.5994	857.8997	546.0353	334.5998	333.8978	607.4598	955.2214	1286.8185	1563.4109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	617.2957	493.9981	408.3166	232.5928	101.4744	0.0000	0.0000	0.0000	0.0000	190.7087	399.3088	621.2005	(98)
Space heating												3064.8956	(98)
Space heating per m2											(98) / (4) =	32.0227	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3386.6249	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	617.2957	493.9981	408.3166	232.5928	101.4744	0.0000	0.0000	0.0000	0.0000	190.7087	399.3088	621.2005	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	682.0947	545.8543	451.1786	257.0086	112.1264	0.0000	0.0000	0.0000	0.0000	210.7278	441.2252	686.4094	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7751	89.7226	89.5809	89.2722	88.6450	87.3000	87.3000	87.3000	87.3000	89.0896	89.5752	89.7950	(217)
Fuel for water heating, kWh/month													
	194.2461	170.4271	177.1873	156.4758	152.3001	135.0886	126.8064	143.1997	144.2255	162.7443	174.7831	188.5587	(219)
Water heating fuel used												1926.0428	(219)
Annual totals kWh/year													
Space heating fuel - main system												3386.6249	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4373.2963	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3386.6249	9.7400	329.8573	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.0428	9.7400	187.5966	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	416.0794	36.8500	153.3252	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			275.2955	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3386.6249	0.2160	731.5110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0428	0.2160	416.0252	(264)
Space and water heating			1147.5362	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			660.0024	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3386.6249	1.2200	4131.6824	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0428	1.2200	2349.7722	(264)
Space and water heating			6481.4546	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			3597.5843	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 37.5884 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 80	-192 kg (29.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£80	2.00 kg/m²	A 92	A 94
Total Savings	£80	2.00 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£181	£199	-£18
Mains gas	£621	£523	£98
Space heating	£461	£461	£0
Water heating	£188	£108	£80
Lighting	£153	£153	£0
Generated (PV)	-£527	-£527	£0
Total cost of fuels	£275	£195	£80
Total cost of uses	£275	£195	£80
Delivered energy	46 kWh/m²	36 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	38 kWh/m²	26 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.9300	
Infiltration rate			0.4082	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5204	0.5102	0.5000	0.4490	0.4388	0.3878	0.3878	0.3776	0.4082	0.4388	0.4592	0.4796	(22b)
Effective ac	0.6354	0.6302	0.6250	0.6008	0.5963	0.5752	0.5752	0.5713	0.5833	0.5963	0.6054	0.6150	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.8790	51.4497	51.0289	49.0522	48.6824	46.9608	46.9608	46.6420	47.6240	48.6824	49.4306	50.2127	(38)
Heat transfer coeff	125.6637	125.2344	124.8135	122.8369	122.4671	120.7455	120.7455	120.4267	121.4086	122.4671	123.2152	123.9974	(39)
Average = Sum(39)m / 12 =												122.8351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3130	1.3085	1.3041	1.2834	1.2796	1.2616	1.2616	1.2582	1.2685	1.2796	1.2874	1.2956	(40)
HLP (average)												1.2834	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                                    Total = Sum(45)m =    1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                        3.0000 (H1)
Zero-loss collector efficiency                                                                                                          0.7000 (H2)
Collector heat loss coefficient                                                                                                         1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                               0.0050 (H3a)
Collector effective heat loss coefficient                                                                                               1.8063 (H3b)
Collector performance ratio                                                                                                             2.5804 (H4)
Annual solar radiation per m2                                                                                                        1079.5246 (H5)
Overshading factor                                                                                                                      0.8000 (H6)
Solar energy available                                                                                                               1813.6014 (H7)
Adjustment factor for showers                                                                                                           1.0000 (H7a)
Solar-to-load ratio                                                                                                                     1.1734 (H8)
Utilisation factor                                                                                                                      0.5735 (H9)
Collector performance factor                                                                                                            0.8793 (H10)
Dedicated solar storage volume                                                                                                         75.0000 (H11)
Effective solar volume                                                                                                                 75.0000 (H13)
Daily hot water demand                                                                                                                 98.2325 (H14)
Volume ratio Veff/V                                                                                                                     0.7635 (H15)
Solar storage volume factor                                                                                                             0.9460 (H16)
Solar input                                                                                                                          -865.2421 (H17)
Solar input    -25.0903   -41.8685   -71.3068   -95.5652  -118.0628  -116.0745  -114.5405  -100.0746   -78.3785   -53.5233   -29.7607   -20.9963 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -865.2421 (63)
Output from w/h
              149.2944   111.0432    87.4191    44.1241    16.9437     1.8579     0.0000    24.9387    47.5304    91.4649   126.8017   148.3200 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =     849.7380 (64)
Heat gains from water heating, kWh/month
               56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

```
Solar gains    155.5904   263.2159   358.0944   444.7776   502.4434   501.5545   482.3456   438.3274   387.6537   290.0901   185.9644   133.4461 (83)
Total gains    773.5919   876.2181   946.8805   996.1008  1015.3269   980.2535   941.2850   906.3842   877.4794   817.6031   755.2474   734.4099 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           35.6973    35.8197    35.9404    36.5188    36.6291    37.1513    37.1513    37.2497    36.9484    36.6291    36.4067    36.1770
alpha          3.3798     3.3880     3.3960     3.4346     3.4419     3.4768     3.4768     3.4833     3.4632     3.4419     3.4271     3.4118
util living area
                0.9781     0.9655     0.9439     0.8995     0.8172     0.6769     0.5279     0.5631     0.7576     0.9095     0.9653     0.9813 (86)

MIT           19.2958    19.5123    19.8343    20.2451    20.6041    20.8596    20.9559    20.9440    20.7781    20.3215    19.7432    19.2627 (87)
Th 2          19.8307    19.8342    19.8376    19.8538    19.8569    19.8711    19.8711    19.8737    19.8656    19.8569    19.8507    19.8443 (88)
util rest of house
                0.9731     0.9578     0.9307     0.8745     0.7685     0.5900     0.4075     0.4442     0.6816     0.8818     0.9561     0.9771 (89)
MIT 2         17.6008    17.9144    18.3774    18.9651    19.4470    19.7616    19.8495    19.8440    19.6741    19.0832    18.2620    17.5615 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.1521 (91)
MIT           17.8587    18.1575    18.5991    19.1598    19.6230    19.9286    20.0178    20.0114    19.8420    19.2716    18.4874    17.8203 (92)
Temperature adjustment                                                                                                                 -0.1500
adjusted MIT  17.7087    18.0075    18.4491    19.0098    19.4730    19.7786    19.8678    19.8614    19.6920    19.1216    18.3374    17.6703 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9406	0.9097	0.8513	0.7493	0.5820	0.4071	0.4428	0.6681	0.8587	0.9389	0.9651	(94)
Useful gains	742.4346	824.2084	861.3684	847.9524	760.7567	570.5477	383.1919	401.3198	586.2451	702.1070	709.0890	708.7894	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1684.9816	1641.5064	1491.4048	1241.8598	951.9388	625.2966	394.5769	416.8415	678.9174	1043.6113	1384.6144	1670.2846	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	701.2550	549.2243	468.7470	283.6134	142.2395	0.0000	0.0000	0.0000	0.0000	254.0793	486.3783	715.3524	(98)
Space heating												3600.8892	(98)
Space heating per m2											(98) / (4) =	37.6229	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3978.8830	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	701.2550	549.2243	468.7470	283.6134	142.2395	0.0000	0.0000	0.0000	0.0000	254.0793	486.3783	715.3524	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	774.8674	606.8777	517.9525	313.3849	157.1707	0.0000	0.0000	0.0000	0.0000	280.7506	537.4346	790.4447	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9214	89.9455	89.9816	90.0556	90.1483	87.3000	87.3000	87.3000	87.3000	89.6304	89.8192	89.9339	(217)
Fuel for water heating, kWh/month	166.0276	123.4560	97.1522	48.9965	18.7953	2.1281	0.0000	28.5666	54.4449	102.0468	141.1744	164.9212	(219)
Water heating fuel used												947.7098	(219)
Annual totals kWh/year													
Space heating fuel - main system												3978.8830	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4189.5151	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3978.8830	3.4800	138.4651	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.7098	3.4800	32.9803	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			194.2249	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5797	(257)
SAP value	91.9127	
SAP rating (Section 12)	92	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3978.8830	0.2160	859.4387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.7098	0.2160	204.7053	(264)
Space and water heating			1064.1441	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			681.6007	(272)
CO2 emissions per m2			7.1200	(273)
EI value			93.5090	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.9300	
Infiltration rate		0.4082	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4082	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4286	0.3980	0.4082	0.3878	0.3878	0.3776	0.3674	0.3572	0.3469	0.3776	0.3572	0.3776	(22b)
Effective ac	0.5918	0.5792	0.5833	0.5752	0.5752	0.5713	0.5675	0.5638	0.5602	0.5713	0.5638	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.3211	47.2881	47.6240	46.9608	46.9608	46.6420	46.3317	46.0299	45.7366	46.6420	46.0299	46.6420	(38)
Heat transfer coeff	122.1057	121.0728	121.4086	120.7455	120.7455	120.4267	120.1164	119.8145	119.5212	120.4267	119.8145	120.4267	(39)
Average = Sum(39)m / 12 =												120.5521	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2758	1.2650	1.2685	1.2616	1.2616	1.2582	1.2550	1.2518	1.2488	1.2582	1.2518	1.2582	(40)
HLP (average)												1.2596	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3132 (H8)
Utilisation factor	0.5330 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	98.2325 (H14)
Volume ratio Veff/V	0.7635 (H15)
Solar storage volume factor	0.9460 (H16)
Solar input	-899.9506 (H17)

Solar input	-29.3586	-41.7460	-71.7514	-96.8092	-113.7082	-121.4583	-118.9041	-106.4227	-83.3217	-57.6057	-34.7234	-24.1413 (63)

Solar input (sum of months) = Sum(63)m = -899.9506 (63)

Output from w/h

	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750 (64)

Total per year (kWh/year) = Sum(64)m = 822.9189 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	13.4839	0.4600	0.0000	0.7700	24.1665	(74)
East	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(76)
South	4.3100	56.7559	0.4600	0.0000	0.7700	86.6436	(78)
West	0.7200	25.1925	0.4600	0.0000	0.7700	6.4247	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	190.6023	274.4744	377.7227	475.9279	515.0217	560.4054	533.9226	493.9804	433.0960	326.6197	227.0461	160.7324 (83)
Total gains	808.6038	887.4767	966.5088	1027.2511	1027.9053	1039.1043	992.8621	962.0372	922.9217	854.1327	796.3290	761.6962 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7375	37.0509	36.9484	37.1513	37.1513	37.2497	37.3459	37.4400	37.5319	37.2497	37.4400	37.2497	
alpha	3.4492	3.4701	3.4632	3.4768	3.4768	3.4833	3.4897	3.4960	3.5021	3.4833	3.4960	3.4833	
util living area	0.9720	0.9608	0.9336	0.8768	0.7760	0.5979	0.4531	0.4649	0.6931	0.8775	0.9518	0.9758	(86)
MIT	19.4883	19.6537	19.9766	20.3728	20.7061	20.9162	20.9760	20.9742	20.8539	20.4769	19.9542	19.4773	(87)
Th 2	19.8598	19.8684	19.8656	19.8711	19.8711	19.8737	19.8762	19.8787	19.8812	19.8737	19.8787	19.8737	(88)
util rest of house	0.9656	0.9519	0.9181	0.8465	0.7177	0.5011	0.3309	0.3405	0.6055	0.8404	0.9389	0.9701	(89)
MIT 2	17.8972	18.1395	18.5974	19.1505	19.5844	19.8169	19.8669	19.8686	19.7671	19.3035	18.5812	17.8909	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1393	18.3698	18.8072	19.3365	19.7550	19.9842	20.0356	20.0368	19.9324	19.4820	18.7901	18.1323	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9893	18.2198	18.6572	19.1865	19.6050	19.8342	19.8856	19.8868	19.7824	19.3320	18.6401	17.9823	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9505	0.9342	0.8965	0.8241	0.7019	0.4974	0.3319	0.3414	0.5969	0.8182	0.9195	0.9564	(94)
Useful gains	768.5779	829.1230	866.4772	846.5539	721.5094	516.8565	329.5773	328.4585	550.8598	698.8925	732.2230	728.4640	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1598.2764	1564.2393	1415.2899	1169.5994	857.8997	546.0353	334.5998	333.8978	607.4598	955.2214	1286.8185	1563.4109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	617.2957	493.9981	408.3166	232.5928	101.4744	0.0000	0.0000	0.0000	0.0000	190.7087	399.3088	621.2005	(98)

Space heating 3064.8956 (98)
Space heating per m2 (98) / (4) = 32.0227 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3386.6249 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	617.2957	493.9981	408.3166	232.5928	101.4744	0.0000	0.0000	0.0000	0.0000	190.7087	399.3088	621.2005	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	682.0947	545.8543	451.1786	257.0086	112.1264	0.0000	0.0000	0.0000	0.0000	210.7278	441.2252	686.4094	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8733	89.8947	89.9212	89.9866	89.9282	87.3000	87.3000	87.3000	87.3000	89.4695	89.7310	89.8759	(217)
Fuel for water heating, kWh/month	161.3674	123.6621	96.7231	47.6517	23.6836	0.0000	0.0000	21.2950	48.7826	97.6673	135.7824	161.5283	(219)

Water heating fuel used 918.1434 (219)
Annual totals kWh/year
Space heating fuel - main system 3386.6249 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) = -1430.4508 -1430.4508 (233)
Total delivered energy for all uses 3415.3969 (238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3386.6249	9.7400	329.8573	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	918.1434	9.7400	89.4272	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	416.0794	36.8500	153.3252	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			195.5511	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3386.6249	0.2160	731.5110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.1434	0.2160	198.3190	(264)
Space and water heating			929.8300	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1430.4508		0.5190	-742.4040 (269)
Total kg/year				468.2462 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3386.6249	1.2200	4131.6824	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.1434	1.2200	1120.1350	(264)
Space and water heating			5251.8174	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			2521.4470	(272)
Primary energy kWh/m2/year			26.3447	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.0600	81.1852	0.4600	0.0000	0.9000	170.0700
East	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	4.3100	112.2060	0.4600	0.0000	0.9000	200.2137
West	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	3.3300	112.2060	0.4600	0.0000	0.9000	154.6894
total:						595.0261

	Jun	Jul	Aug	
Solar gains	626	595	550	(P4)
Internal gains	476	456	465	
Total summer gains	1102	1051	1015	(P5)
Summer gain/loss ratio	2.75	2.63	2.54	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.57	21.34	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight